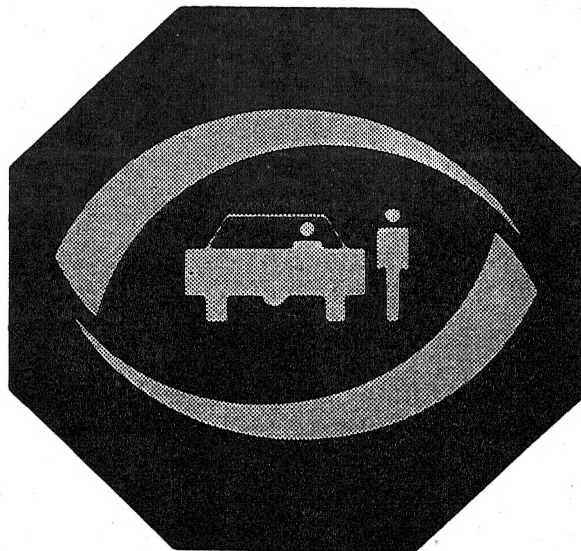


Shelve in stacks S.B.T.

An Announcement of **Highway Safety Literature** ... A Bi-Monthly Abstract Journal



HSL No. 72-20
October 20, 1972



**SPECIAL ANNOUNCEMENT
ON PAGE 22**

THIS ISSUE CONTAINS:
HS-011 628 — HS-011 706
HS-800 690

U.S. Department of Transportation / National Highway Traffic Safety Administration

HSL No. 72-20 October 20, 1972 HS-011 628 — HS-011 706; HS-800 690

72-20

An Announcement of
HIGHWAY SAFETY LITERATURE
... A Bi-Monthly Abstract Journal

Published twice-a-month by the National Highway Traffic Safety Administration,
Research Institute, Office of Accident Investigation and Data Analysis
Washington, D.C. 20590

INTRODUCTION

Publications such as journal articles, proceedings, and research reports announced in *Highway Safety Literature* include some of the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 72 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in locating citations by the HS-number, the cover bears the inclusive entry number for each issue.

Entries in *HSL* are arranged according to the NHTSA Subject Category List shown in the Table of Contents. The list is a two-level arrangement consisting of five major subject fields subdivided into 59 subject groups. Documents related directly to

the National Highway Traffic Safety Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration. HS-800 000 series and HS-820 000 series are available for purchase from NTIS or GPO (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array _____
NHSB Accession no. HS-800 218 Fld. 5/21; 5/9
Title of document AN INVESTIGATION OF USED CAR
SAFETY STANDARDS-SAFETY
INDEX: FINAL REPORT. VOL. 6 -
APPENDICES G-L
Personal author(s) by E. N. Wells; J. P. Fitzmaurice; C. E.
Guilliams; S. R. Kalin; P. D. Williams
Corporate author Operations Research, Inc.
Collation _____
Publication date 1969 150p
Contract FH-11-6921
Report no. ORI-TR-553-Vol-6; PB-190
523
Abstract Appendices G-L to this study of used
car safety standards include: indenture
model diagrams for classes I-IV motor
trucks; degradation, wear, and failure
data for motor truck classes I-IV; and
safety index tables for classes I-IV
motor trucks.
Search terms; Wear; Trucks;
Failures; Used cars; Inspection
standards

AVAILABILITY: NTIS

HS-004 497 Fld. 5/19

**AUTO THEFT--THE PROBLEM AND
THE CHALLENGE**

by Thomas A. Williams, Sr.

Journal citation Published in *FBI Law Enforcement
Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto
theft problem and comments on anti-
theft devices available now or in the
planning stage.

Search terms: Theft; Theft pro-
tection; Stolen cars

(Note: If the date of a report or
Journal article is not given, the small
letters nd will appear)

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NOTE: () Numbers in parentheses following certain subject groups indicate the Highway Safety Program Standards (No. 1, and up) and/or Federal Motor Vehicle Safety Standards (No. 101 and up) which may apply to these groups.

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NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brand names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval of any particular product, course, or equipment by the U.S. Department of Transportation, National Highway Traffic Safety Administration.

Harry A. Feinberg
Managing Editor

AVAILABILITY OF DOCUMENTS AND INSTRUCTIONS FOR ORDERING

Articles and reports whose citations and abstracts appear in HSL are acquired from many sources, such as periodicals, journals, NHTSA Contractors' reports and NHTSA staff speeches, and other reports. Those reports other than NHTSA Contractors' reports and NHTSA generated reports and speeches (see introduction) are assigned a lower consecutive accession (HS-) number.

Department of Transportation personnel may borrow copies of publications announced in HSL from the NHTSA Technical Reference Division. Non-DOT Personnel, in the Washington, D.C. area, may borrow copies of publications for a 24-hour period only. Telephone (202) 426-2768. Government personnel in the Washington, D.C. area, use government ID phone 118-62768.

The names of the journals cited in HSL appear in *italic type* preceded by the words "Published in." The journal containing the article cited may be borrowed from most research and public libraries. Non-DOT personnel outside the Washington area should contact their company or agency libraries for assistance.

(Use any of the most recent *periodical directories* for location and price of publications cited in HSL)

NHTSA Contractors' reports and other reports can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that copies will be available for more than a limited period after a report is issued.

The more common availability sources are identified by symbols which are explained in the next column:

NTIS: National Technical Information Service, Springfield, Va. 22151. Order by accession number: HS, AD, or PB. Prepayment is required by NTIS coupon, check or money order (made payable to NTIS). GPO coupons are not acceptable. Documents are available in paper copy (PC); in full size original or reduced facsimile, and on microfiche (MF) a 4x6" negative sheet of film (reader required).

GPO: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS coupons are not acceptable), check or money order (made payable to the Superintendent of Documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C. 20418.

NHTSA: National Highway Traffic Safety Administration, General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874), Give HS-No.

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report numbers. Prices given are list; discounts are available to SAE members and sometimes to libraries and U.S. Government Agencies. Prepayment is required; orders received without payment are subject to a \$1 handling charge.

IMPORTANT NOTICE

WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS, add DOT/to the prefix HS; example HS-800 000 should be ordered as DOT/HS-800 000.

1/0 ACCIDENTS

1/1 Emergency Services

HS-011 628 Fld. 1/1; 4/7

OPTIMIZING AMBULANCE SERVICES FOR SEMI-RURAL COUNTIES

by N. K. Geller; S. R. Kennedy

Published in *HIT LAB Reports* p1-9 (Feb 1972)

2refs

An analytical modeling method developed to provide a tool for evaluating the potential effectiveness of alternative ambulance service location schemes for semi-rural (i.e., mixed urban and rural) areas is presented. Its application in a specific semi-rural county situation (Washtenaw County, Michigan) is described.

Search terms: Emergency medical services; Ambulances; Mathematical models; Computerized simulation; Michigan; Rural areas; Urban areas; Simulation models

1/5 Statistical Data

HS-011 629 Fld. 1/5

THE 1971 TRAFFIC STORY. NUMBERS UP, RATE DOWN

by J. L. Recht

Published in *Traffic Safety* v72 n3 p9-11, 28-9, 38-9 (Mar 1972)

Motor-vehicle deaths increased less than .5% in 1971 over 1970. During 1971, deaths were lower than the previous year's totals in six of the 12 months, and higher in the other six. The mileage death rate in 1971 was 4.7 per 100 million vehicle miles, the lowest on record. Rates of injuries, turnpike accidents, urban and rural fatalities, deaths by accident

type, deaths by age of victim, and changes between 1970 and 1971 rates are given.

Search terms: Fatality rates; Accident types; Fatalities by age; Injury statistics; Rural accidents; Urban accidents; Accident statistics; Accident rates; Injury rates; Vehicle mileage

1/2 Injuries

HS-011 630 Fld. 1/2

THE DYNAMIC BEHAVIOUR OF THE HEAD AND CERVICAL SPINE DURING "WHIP-LASH"

by J. A. McKenzie; J. F. Williams

Published in *Journal of Biomechanics* v4 n6 p477-90 (Dec 1971)

24refs

A discrete-parameter model of the head, neck, and torso has been developed. Following a 5g acceleration pulse applied to the seat base it was found that some degree of initial flexion of the head relative to the torso occurred prior to rapid hyperextension. The degree of initial flexion was found to increase with decreasing seat back stiffness. Head, horizontal, and rotational acceleration profiles revealed that the peak values reached displayed a similar relationship to seat back stiffness. An examination of the loading distribution in the cervical spine showed that maximums were reached during the hyperextension phase and were of greatest magnitude in the low cervical region. These factors were larger and consequently more damaging for seat backs of decreasing stiffness characteristics.

Search terms: Whiplash injuries; Cervical spine impact tolerances; Mathematical models; Head acceleration tolerances; Seat backs; Stiff-

ness; Occupant kinetics; Head motion range; Flexion; Equations of motion; Human body simulation

1/3 Investigation

HS-011 631 Fld. 1/3; 3/4

THE HUMAN FACTOR IN ROAD ACCIDENT CAUSATION

by D. J. M. Vorster; D. M. van der Nest

National Inst. for Personnel Res. (South Africa)

1970 49p 28refs

Presented at the tenth meeting of the South African Road Safety Council, Durban, 31 Oct 1969.

The roles of the road and other environmental factors, the vehicle, and the road user in causing accidents are discussed. Human requirements for preventing accidents are related to traffic communication, human abilities, driver characteristics and education, and driver control. Reasons for human failure in the driving task are described. Levels of road usage and their relevance to human characteristics and defects are discussed. The incidence of accidents caused by human factors can be controlled by emphasis on: vehicle and road design; selection and training of road-users; limitations on density of traffic; and an effective control system.

Search terms: Driver vehicle road interfaces; Accident causes; Accident statistics; Human factors; Driver mental fitness; Environmental factors; Road conditions; Driver skills; Driver personality; Driver education; Driver physical fitness; Highway communication; Drinking drivers; Accident prevention; Driver characteristics; Driving tasks; Driver errors; Republic of South Africa

1/4 Locations

HS-011 632 Fld. 1/4; 2/4; 2/9

STATE-OF-THE-ART OF
WRONG-WAY DRIVING ON
FREEWAYS AND EXPRESS-
WAYS

by J. D. Friebele; C. J. Messer; C. L. Dudek

Texas A and M Univ. Texas Transp. Inst.

1971 44p 20refs
Report no. RR-139-7; PB-204 823

Sponsored by Texas Hwy. Dept. in cooperation with the Federal Hwy. Administration.

The extent and causes of wrong-way driving as well as preventive measures that are used or could be used are reviewed to provide additional insight in the development of a detection and communication system to warn drivers of wrong-way maneuvers. Eleven conclusions on the relationship of road design and driver error are given. It is recommended that ways must be sought to reduce drunk driving, a major factor in wrong way accidents; that additional research be undertaken to determine what geometric features of the road influence wrong way maneuvers; that the feasibility of divergent ramps for redirecting wrong way vehicles be studied; and that the effectiveness of detection and communication systems for warning drivers of wrong way movement on ramps and roads should be evaluated.

Search terms: Freeway driving; Wrong way driving; Access violations; Accident causes; Cloverleaf interchanges; Drinking drivers; Ramp control; Wrong way signals; Vehicle detectors; Wrong way signs; Driver confusion; Pavement markings; State of the art studies; Driver intoxication; Warning systems; Driver road interface; Highway charac-

teristics; Driver errors; Sight distances; Accident prevention

AVAILABILITY: NTIS as PB-204 823

1/5 Statistical Data

HS-011 633 Fld. 1/5

OPERATION 500. INTERSTATE
80 ACCIDENTS. FINAL RE-
PORT

by B. Mason

California Dept. of Hwy. Patrol

1970 93p
Report no. FR-IV-A2

An analysis of the accidents which occurred on highway I-80 in the San Francisco Bay area for the period 1 Sep. 1966 through 31 Oct. 1967 is presented. Data are tabulated for accidents compared with average daily traffic; accident victims; accidents by type, by day of week, by hour of day, by collision cause, and by mile-post; and driver at fault.

Search terms: Interstate Highway System; Accident statistics; Traffic volume; Fatalities by age; Injuries by age; Fatalities by sex; Injuries by sex; California; Property damage accidents; San Francisco; Single vehicle accidents; Time of accidents; Accident types; Accident causes; Mileposts; Male drivers; Female drivers; Driver characteristics; Accident responsibility; Day of week; Accident location; Accident rates; Fatality rates; Injury rates

HS-011 634 Fld. 1/5

TRAFFIC ACCIDENT FACTS,
1970

Washington State Patrol

1971 34p

Statistics for the state of Washington for 1970 are tabulated and graphed.

Data include: types of motor vehicle accidents; accidents by location (urban vs. rural areas, county); death rates per 100 million vehicle miles; fatalities and accidents by month, day of week, time of day, age groups; seat belt use studies; driver characteristics; driver violations; vehicle characteristics; motorcycle accidents; pedestrian characteristics; directional analysis; road and light conditions; motor vehicle deaths on major holidays.

Search terms: Driver characteristics; Seat belt usage; Accident statistics; Accident rates; Injury statistics; Traffic accidents; Accident types; Motorcycle accidents; Month; Washington (State); Vehicle characteristics; Pedestrian accidents; Traffic law violations; Urban accidents; Rural accidents; Time of day; Day of week; Age factor in accidents; Light conditions; Fatality rates; Accident location; Road conditions; Holidays; Pedestrian characteristics

HS-011 635 Fld. 1/5

AGES OF CAR DRIVER CASU-
ALTIES IN 1970

by H. D. Johnson

Road Res. Lab. (England)

1972 9p 4refs
Report no. RRL-LR-431

About one-half of the male car drivers killed or injured between 10 p.m. and 4 a.m. are under 25 years old. The proportion is about one-quarter during the light hours, 10 a.m. and 4 p.m., and it is nearly 30% during the rest of the day. It was assumed that during the above dark hours the casualty rate for drivers of any one age group is double that during the day hours, and during the mixed hours (4 a.m. to 10 a.m. and 4 p.m. to 10 p.m.) is 25% above it. It was then found

that if the distances driven by young (under 25 years of age) car drivers was distributed over the day in the same way as for older drivers, their casualty rate would be about 9% lower than it is at present. It would, however, still be more than 2 1/2 times the rate of older drivers.

Search terms: Driver age; Time of accidents; Great Britain; Fatalities by age; Fatalities by sex; Male drivers; Female drivers; Fatality rates; Young adult drivers; Injury rates; Seasons

HS-011 636 Fld. 1/5; 1/2

FATAL AND INJURY ACCIDENT RATES ON FEDERAL-AID AND OTHER HIGHWAY SYSTEMS/1970

Federal Hwy. Administration

1971 40p

Statistics compiled from reports submitted by the 50 States and the District of Columbia are tabulated. A comparison of fatality rates by highway system from 1967-70 is presented.

Search terms: Fatalities; Fatality rates; Injury rates; Accident rates; Rural accidents; Urban accidents; Interstate Highway System; Highway mileage; Vehicle mileage; Injury statistics; Accident statistics; Highway characteristics; Accident location

AVAILABILITY: GPO \$0.45

HS-011 637 Fld. 1/5; 3/3

CHARACTERISTICS OF YOUTHFUL BICYCLE RIDERS IN AN URBAN COMMUNITY AND EVENTS ACCRUING TO OPERATION OF THEIR VEHICLES

by E. A. Pascarella; J. P. Foley; D. N. Levine; J. R. Stewart

North Carolina Univ. Hwy. Safety Res. Center

1971 122p 19refs

Cover title: A Study of Youthful Bicycle Riders in an Urban Community.

Accident data for Raleigh, North Carolina were accumulated through three levels of reporting: hospital emergency rooms, police records, and a monthly report form that was sent to subjects who agreed to participate in the data collection phase of the study. An estimate of exposure was calculated through use of a cyclometer. It was determined that the three types of bicycles identified in the study (highrise, lightweight, and standard) experienced accidents at rates which did not attain statistical significance. Observed rates for accident occurrence for males, as compared to females, and by age groups was also not statistically different. It was observed that younger riders will be likely to sustain the more serious accidents, while the older rider will more often be involved in a police-reported situation.

Search terms: Bicycle accidents; Bicycle rider age; Age factor in accidents; Sex factor in accidents; Bicycle rider injuries; Accident statistics; Accident location; Light conditions; Weather; Day of week; Questionnaires; Accident report forms; Raleigh; Accident studies; Bicycle rider behavior; Bicycle characteristics; Accident risks; Accident rates; Statistical analysis; Time of accidents; Vehicle mileage

2/0 HIGHWAY SAFETY

2/4 Design and Construction

HS-011 638 Fld. 2/4

FLEXBEAM REDIRECTIONAL SYSTEM FOR THE MODULAR CRASH CUSHION

by G. G. Hayes; D. L. Ivey; T. J. Hirsch

Texas A and M Univ. Texas Transp. Inst.

1970 47p 4refs
Report no. RR-146-3; PB-204 529

Sponsored by Texas Hwy. Dept. in cooperation with the Federal Hwy. Administration.

The modular crash cushion of empty modified 55-gallon oil drums which is now in field use has proven to be highly successful, especially in head-on collisions. However, it does have a potential danger zone near the back. When impacting in this danger zone, a vehicle can pocket and contact the rigid obstacle before losing a significant amount of energy. It is evident that, in this danger zone, redirection would normally be more desirable than complete arrestment. A set of steel drums wrapped with a flexbeam of W-section guard-rail has been added to the rear portion of the modular crash cushion to prevent pocketing of impacting vehicles. Longitudinal cables on each side of the front portion of the crash cushion serve to redirect vehicles hitting the sides. Drawings of the revised structure incorporating these features show details for construction.

Search terms: Crash cushions; Impact tests; High speed impact tests; High speed photography; Angle impact tests; Impact attenuators; Barrier collision tests; Test equipment; Barrier design

AVAILABILITY: NTIS as PB-204 529

2/9 Traffic Control

HS-011 639 Fld. 2/9; 3/4

EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF ROADWAY MARKINGS ON VEHICLES STOPPING IN PEDESTRIAN CROSSWALKS

2/9 Traffic Control (Cont'd.)**HS-011 639 (Cont'd.)**by R. G. Mortimer; M. Nagamachi;
W. L. CarlsonMichigan Univ. Hwy. Safety Res.
Inst.1969 34p 5refs
Report no. HSRI-HuF-4

The purpose of the experiment was to identify some of the roadway, vehicle, and driver factors influencing the stopping position of vehicles at a traffic signal controlled intersection and to suggest effective means to prevent vehicles from stopping in the pedestrian crosswalk. The site chosen was the intersection of a one-way and a two-way street. Markings on the two streets and the height of the traffic signal were varied to determine their influence on stopping position. The effects of driver sex, type and size of vehicles, direction taken after stopping, traffic flow, one-way/two-way street, and lane position were also studied. It was found that greatest control of stopping position, with minimum vehicle encroachment in the crosswalk, was achieved by the use of a stop line across the traffic lane which was not nearer to the intersection than 20 feet.

Search terms: Stopping distance; Signalized intersections; Stopping point; Pedestrian crossings; Crosswalks; Pavement markings; One way streets; Two way traffic; Driver sex; Driver characteristics; Traffic flow; Traffic lanes; Vehicle size; Vehicle characteristics; Driver behavior research; Variance analysis

HS-011 640 Fld. 2/9; 4/8**STAVING OFF AUTO PARALYSIS**

Anonymous

Published in *Business Week* n2113
p54-6, 58 (28 Feb 1970)

Today's 100 million cars and trucks will grow to 170 million by 1985, almost all squeezed into metropolitan areas. Traffic engineers who must deal with three essential areas—commuting, circulation within the city, and parking—believe that the answer to the traffic problem is rapid transit.

Search terms: Traffic congestion; Traffic management; Rapid transit systems; Peak hour traffic; Urban traffic flow; Parking; Public transportation

3/0 HUMAN FACTORS**3/1 Alcohol****HS-011 641 Fld. 3/1****CAPABILITIES AND REQUIREMENTS FOR BLOOD ALCOHOL TESTING OF MICHIGAN TRAFFIC FATALITIES**

by L. D. Filkins; D. J. Minahan

Michigan Univ. Hwy. Safety Res.
Inst.

1969 43p 19refs

Michigan's conformity to Highway Safety Program Standard 4.4.8, Alcohol in Relation to Highway Safety, is analyzed. An investigation of state and county programs indicates that Michigan does not have a program for sampling and chemically analyzing blood from drivers and pedestrians killed in traffic accidents as required by Standard 4.4.8. Recommendations regarding legislative, administrative, and financial requirements for the implementation or improvement of a state-wide program fully in keeping with this standard are made.

Search terms: Michigan; Alcohol blood tests; Blood alcohol levels; Highway safety standards; Safety standards compliance; Driver fatalities; Pedestrian fatalities

HS-011 642 Fld. 3/1**ALCOHOL USAGE OF THE NIGHTTIME DRIVER**

by W. L. Carlson

Published in *Journal of Safety Research* v4 n1 p12-25 (Mar 1972)

9refs

Sponsored in part by the National Hwy. Traf. Safety Administration.

Alcohol usage in the general night driving population is compared with use in the population of persons involved in single-vehicle crashes at night. Randomly selected night drivers were given a breath test for alcohol and a short interview. Heavy alcohol usage was observed in the early morning driving population as well as a corresponding increase in alcohol-related crashes. Persons inexperienced in drinking and driving (young drivers and women) were found to be involved in crashes at lower blood alcohol concentrations. The study was made in Washtenaw County, Michigan. A study made in Mecklenburg County, North Carolina is also discussed briefly.

Search terms: Alcohol breath tests; Blood alcohol levels; Alcohol usage; Night driving; Michigan; Time of day; Traffic volume; Driver educational levels; Male drivers; Female drivers; North Carolina; Young adult drivers; Drinking drivers; Marital status; Driver occupation; Single vehicle accidents; Driver age; Driver sex; Driver interviews; Driver intoxication; Driver social class

HS-011 643 Fld. 3/1**THE VARIABILITY OF COLLISION INVOLVEMENT AT LOW BLOOD ALCOHOL CONCENTRATIONS: THE GRAND RAPIDS CURVE EXPLAINED**

by R. Zylman

Published in *Blutalkohol* v9 n1
p25-32 (Jan 1972)

11refs

The curve from the Grand Rapids study showed that drivers with BACs (blood alcohol concentrations) of 0.01% to 0.04% are less likely to cause a collision than those who had not been drinking. This has been interpreted to mean that drivers could drive more safely after drinking a little, and thus became controversial. The author points out that was an average for the 24-hour day while the low BAC driver operated a car at a time of day when traffic density was light. Further, the low BAC drivers were more often from the better driving age groups who had more experience in both driving and drinking. In heavy daytime traffic even low BAC drivers tended to be involved in more collisions than those who had not been drinking.

Search terms: Blood alcohol levels; Drinking drivers; Time of day; Traffic density; Driver experience; Accident risk forecasting; Probability theory; Accident rates

HS-011 644 Fld. 3/1

ASCERTAINING POLICE BIAS IN ARRESTS FOR DRUNKEN DRIVING

by M. M. Hyman; A. R. Helrich; G. Besson

Published in *Quarterly Journal of Studies on Alcohol* v33 n1 p148-59 (1972)

12refs

This is a study of 640 men in the 25-64 age group arrested for driving while intoxicated in Santa Clara Co., Calif. and 383 in the Columbus, Ohio metropolitan area in 1962. Arrest rates for Spanish-Americans in

Santa Clara and Negroes in Ohio were higher than for whites. The study concluded that the high arrest rate among the minorities reflects a greater frequency of drunken driving among them rather than a police bias in arrests.

Search terms: Drinking drivers; Blood alcohol levels; Urine alcohol levels; Racial factors; Sociological factors; Negroes; California; Columbus, Ohio; Arrests; Driver intoxication; Driver social class; Male drivers; Adult drivers; Variance analysis; Racial discrimination; Ethnic groups

HS-011 645 Fld. 3/1

THE DENVER AREA DRINKING-DRIVING SURVEY, 1971

by A. C. Wolfe

Colorado Dept. of Health; Michigan Univ. Hwy. Safety Res. Inst.

1971 137p 17refs
Contract FH-11-7534
Report no. PB-205 283

Subcontracted to Michigan Univ. Hwy. Safety Res. Inst., subcontract 88-166-1.

The results of a household interview with 504 persons of driving age in Denver and its suburbs are summarized. Content areas of the survey include general knowledge and attitudes about highway safety factors; knowledge of the relationship between consumption of various quantities of alcohol and driving impairment; and awareness of and attitudes toward various alcohol counter-measures programs. The survey was carried out to obtain baseline information useful to the development and evaluation of the public information component of the three-year demonstration Denver Alcohol Safety Action Program. Of the respondents, 90% said they had or had had

driver's licenses; 78% said that they drink; 43% said that they do drive after drinking; and 15% admitted that they had driven after drinking more than they should have (self-defined) in the previous year.

Search terms: Surveys; Interviews; Drinking drivers; Denver; Alcohol education; Driver attitudes; Driver age; Driver sex; Racial factors; Driver educational levels; Driver occupation; Alcohol usage

AVAILABILITY: NTIS as
PB-205 283

HS-011 646 Fld. 3/1; 1/2

SOME EFFECTS OF ALCOHOL, AGE OF DRIVER, AND ESTIMATED SPEED ON THE LIKELIHOOD OF DRIVER INJURY

by S. B. White; C. A. Clayton

Published in *Accident Analysis and Prevention* v4 n1 p59-66 (Mar 1972)

13refs

Part of a larger study supported by the North Carolina Governor's Highway Safety Program.

The objectives of the study were to determine if and in what way the likelihood of driver injury is affected by the presence of alcohol and/or driver age; to determine if the effect of the alcohol factor is the same for drivers of all ages; and to investigate how the age and alcohol effects on driver injury change with speed. The North Carolina Traffic Accident File provided the source data for the study. Once an accident has occurred, the study indicates that the likelihood of a driver injury is significantly greater in the presence of alcohol. This effect appears to hold consistently over a wide range of estimated speeds and drivers' ages,

3/1 Alcohol (Cont'd.)**HS-011 646 (Cont'd.)**

three road types, single and multi-vehicle accidents, and for minor, moderate, and serious injuries.

Search terms: North Carolina; Driver age; Speed; Alcohol effects; Drinking drivers; Male drivers; Driver injuries; Single vehicle accidents; Injuries by age; Injury severity; Variance analysis; Accident studies; High speed; Injury factors

HS-011 647 Fld. 3/1; 3/7**A PSYCHIATRIST'S VIEW OF THE HUMAN FACTORS INVOLVED IN SAFETY PLANNING**

by M. S. Rapp

Published in *ASSE Journal* v17 n3 p26-31 (Mar 1972)

13refs

An overview is presented of factors involved in industrial accidents including alcoholism, intoxicating drugs, sedatives and tranquilizers, fatigue, physical diseases, personality problems, and sociological factors. Factors involved in planning and managing safety programs are outlined.

Search terms: Industrial safety; Industrial accidents; Accident causes; Alcoholism; Hallucinogens; Sedatives; Tranquilizers; Fatigue (biology); Medical factors; Safety programs; Personality; Sociological factors

HS-011 648 Fld. 3/1; 3/7**AN EXPERIMENTAL APPROACH TO DRIVER EVALUATION USING ALCOHOL DRINKERS AND MARIHUANA SMOKERS**

by A. Binder

Published in *Accident Analysis and Prevention* v3 n4 p237-56 (1971)

34refs

An experimental procedure was used to evaluate the effects of marihuana smoking and various levels of blood alcohol upon several components of the driving task. To gain certain advantages of the epidemiological method in the experimental setting, subjects were recruited from bars and parties where they had been drinking alcoholic beverages or smoking marihuana in a manner and amount that was customary in the context. It was found that performance decrement increased with blood alcohol content, that differences in performance found under alcohol were in evidence among the same subjects in non-alcohol trials, that marihuana produced performance decrement but apparently to a much lesser degree than alcohol, and that experimenters could predict the motor performance of the drinking subjects by observation of their behavior just prior to the experimental run.

Search terms: Blood alcohol levels; Marijuana; Drug effects; Alcohol effects; Drinking drivers; Questionnaires; Variance analysis; Driver reaction time; Intelligence; Driving task analysis; Motor skills; Driver skills; Tracking; Laboratory tests

HS-011 649 Fld. 3/1; 3/11; 1/3**FACTORS ASSOCIATED WITH ALCOHOL AND RESPONSIBILITY FOR FATAL HIGHWAY CRASHES**

by J. A. Waller

Published in *Quarterly Journal of Studies on Alcohol* v33 n1 p160-70 (1972)

11refs

Responsibility for a crash was determined in 292 automobile drivers and 113 pedestrians, aged 15 and older, killed in Alameda and Sacramento Counties, Calif., during 1960-67. Pedestrians with blood alcohol concentrations of 0.10% or over were responsible in 61% of the fatalities involving pedestrians. Among both pedestrians and drivers, those with 0 BAC were responsible in 47% of the cases; with 0.05-0.099% BAC, 79%; and with 0.15% or over, 89%. BAC was more important in crash responsibility than vehicle age. In teen-agers, nearly all alcohol-related crashes occurred at night and at relatively low BACs.

Search terms: Blood alcohol levels; Drinking drivers; California; Driver intoxication; Accident causes; Drinking pedestrians; Age factor in accidents; Driver fatalities; Passenger fatalities; Accident responsibility; Pedestrian fatalities; Time of accidents; Accident studies

HS-011 650 Fld. 3/1; 4/1**OUR DRUNK DRIVING HABIT**

by W. L. Roper

Published in *California Highway Patrolman* v36 n1 p4-5, 46-8 (Mar 1972)

Federal and California anti-alcoholism projects are reviewed. Harsher driver licensing rules and jail vs safety schools, alcoholism treatment, and rehabilitation programs are debated. The computerized drunk-proof car that only a sober person can drive is discussed and a need is stated for greater driver responsibility.

Search terms: Drinking drivers; Alcohol laws; Driver rehabilitation; Driver license revocation; Alcohol detection and interlock systems; Alcohol usage deterrents; Problem drivers; Alcoholism

3/2 Anthropomorphic Data

HS-011 651 Fld. 3/2; 5/20

ERGONOMIC STUDY OF SNOWMOBILES. FINAL REPORT

by S. Sturgis; R. G. Mortimer; R. W. McCutcheon; C. M. Jorgeson

Michigan Univ. Hwy. Safety Res. Inst.

1970 47p 17refs
Contract ERG-90417-14A
Report no. HSRI-HuF-8

Report for 1 Jul 1969-31 Dec 1969.

One of the most important considerations in the design of machines for human use is the range of body size of the operator population. This study was undertaken for the purpose of determining the extent of the anthropometric fit between snowmobiles and their users. The need for the investigation was apparent from the variety of snowmobiles that are available. The study revealed a number of areas in which greater consideration of human factors would result in a safer and more comfortable vehicle.

Search terms: Snowmobile design; Snowmobile operators; Human factors engineering; Human body size; Anthropometry

3/4 Driver Behavior

HS-011 652 Fld. 3/4

SMOKING, DRIVER EDUCATION, AND OTHER CORRELATES OF ACCIDENTS AMONG YOUNG MALES

by F. L. McGuire

Published in *Journal of Safety Research* v4 n1 p5-11 (Mar 1972)9refs
Contract FH-11-7200

A sample of 2,961 airmen, age 17-20, was administered a variety of tests and a biographical questionnaire, and the resultant variables related to accident frequency. Of 19 variables, 6 were significant upon cross-validation, including the AFQT, mileage, violations, value of parents' home, family income, and smoking habits. High school driver education demonstrated no relationship to accident frequency. The higher accident rate found among smokers may be partially the result of significant oxygen deficiency and/or the possession of certain personality traits.

Search terms: Smoking; Correlation analysis; Accident rates; Male drivers; Young adult drivers; Adolescent drivers; Accident factors; Driver personality; Socioeconomic data; Accident repeater drivers; Driver social class; Driver characteristics; Variables; Driver mileage

HS-011 653 Fld. 3/4

AN ASSESSMENT OF SEX DIFFERENCES IN THE PERFORMANCE OF A SIMULATED DRIVING TASK

by R. E. Hagen

South Dakota Univ.

1971 81p 14refs

Psychomotor performance data were collected from 89 male and 74 female licensed drivers using the Sim-L-Car point-light-source driving simulator. Thirteen measurements involving indices of steering input, accelerator input, speed maintenance, and lateral placement inputs were included. A series of multiple discriminant analyses on the data revealed that the test battery was capable of discrimination between groupings by age, sex, violation, accident, driving

exposure, type of driving, risk, and driver education. Additional discriminant analyses revealed that the test battery was capable of discrimination among violation groupings and accident groupings of the male data and driving exposure groupings of the female data. Descriptive data were obtained from the subjects from a driving questionnaire. It is suggested that accident countermeasure and driver education programs developed on the basis of male driving performance data may need to be reevaluated.

Search terms: Multiple discriminate analysis; Driver performance; Driver sex; Female drivers; Male drivers; Driver characteristics; Driving simulators; Driver age; Traffic law violations; Accident rates; Driving task analysis; Driver mileage; Driver education; Speed changes; Motor skills; Driver experience; Risk taking; Questionnaires; Steering; Acceleration control

HS-011 654 Fld. 3/4; 3/1; 1/3

SUICIDE AND SELF-DESTRUCTION IN AUTOMOBILE ACCIDENT: A PSYCHOANALYTIC STUDY

by N. Tabachnick; C. I. Wold

University of Southern California

1971 20p 12refs
Grant MH-15510

Hypotheses concerning suicide and self-destruction in serious automobile accidents were developed and tested against three groups of male hospital patients. One group was hospitalized for injuries suffered in one-car accidents, the second for suicide attempts, and the third for appendectomies. No cases of suicide were found among the accident victims. Heavy daily drinking was noted in three-fourths of the accident group, compared to one-fourth of the

3/4 Driver Behavior (Cont'd.)**HS-011 654 (Cont'd.)**

suicide attempt and appendectomy sample. It is concluded that suicidal and self-destructive factors do not play as significant a role in the general accident picture as drinking.

Search terms: Suicide by vehicle; Single vehicle accidents; Male drivers; Drinking drivers; Psychological factors; Suicide attempts; Alcoholism; Problem drivers

HS-011 655 Fld. 3/4; 3/9; 3/1**THE HUMAN FACTOR IN AUTOMOBILE ACCIDENTS**

by C. F. Johnson

Published in *Traffic Safety* v72 n3 p13-4, 35-8 (Mar 1972)

Human failure overshadows all other factors in highway accidents. Poor judgment, impaired reaction time, faulty attitudes, emotional disturbances, drinking, drug abuse, and physical disabilities are basically responsible for most accidents. Man is a menace on the road, and until legislation is enacted to protect adequate drivers from inadequate drivers, death rates on the highway will continue to rise.

Search terms: Accident causes; Drinking drivers; Driver intoxication; Drug caused accidents; Driver physical fitness; Epilepsy; Age factor in accidents; Handicapped drivers; Sociological factors; Driver mental fitness; Medical factor caused accidents; Driver license laws; Problem drivers; High risk drivers

HS-011 656 Fld. 3/4; 3/12; 1/3**PERCEPTION MODEL FOR DESCRIBING AND DEALING WITH DRIVER INVOLVEMENT IN HIGHWAY ACCIDENTS**

by R. C. Vanstrum; G. B. Caples

Published in *Highway Research Record* n365 p17-24 (1971)

7refs

Sponsored by Committee on Road User Characteristics and presented at the Highway Research Board 50th annual meeting.

A theory or model relating driver perception and action to road hazards is explored. Research and countermeasures suggested by the model are discussed. Precrash, crash, and post-crash phases are related to the human, vehicle, and environmental factors. Perception is a human, pre-crash factor. Perceptual error is the proximate cause for most preventable accidents. The perception model presented indicates that accidents can be prevented by increasing the margin for error, making the perceptual error always positive, and making the perceptual error as small as possible. Areas for further research are suggested, particularly in generation, transmission, reception, and perception of visual signals.

Search terms: Simulation models; Perception; Crash phase; Precrash phase; Postcrash phase; Environmental factors; Human factors; Vehicle characteristics; Accident causes; Driver errors; Visual perception; Driving task analysis; Hazard perception

3/5 Driver Education**HS-011 657 Fld. 3/5****DDC DOWN UNDER**

by C. Imhoff

Published in *Traffic Safety* v72 n2 p20-2, 34-7 (Feb 1972)

The defensive driving program in New Zealand is a volunteer activity which

supplements the official traffic safety effort. Citizens willing to do volunteer work have made a practical contribution to safety. The defensive driving program began in 1967. The technique used has been to persuade people in leadership roles to take the course first, since they set examples for others and often have their employees take the course.

Search terms: Defensive driving; Community support; Leadership; New Zealand

HS-011 658 Fld. 3/5**PROJECT PRIVAL: EVALUATION OF SEVERAL GROUND SAFETY TRAINING EFFORTS**

by D. H. Schuster

Published in *Journal of Safety Research* v4 n1 p31-9 (Mar 1972)

15refs

Contract F-44620-69-C0002

The purpose of this study was to evaluate the effectiveness of the Private Motor Vehicle Team Chief Program in reducing driving accidents and moving violations. Five educational treatments were assigned to five different air bases in the U.S. The two major criteria were the number of moving violations and accidents per airman while exposed to one of the educational treatments. The results showed that neither the regular PMV program nor the special emphasis versions significantly affected the accidents or violations.

Search terms: Driver education evaluation; Driver improvement measurement; Variance analysis; Military drivers; Drinking drivers; Military personnel accidents; Safety program effectiveness; Program evaluation; Traffic law violations; Accident prevention

HS-011 659 Fld. 3/5; 3/6

RESEARCH CHALLENGES IN DRIVER EDUCATION AND DRIVER LICENSING

by C. H. Hartman

National Hwy. Traf. Safety Adminis-
tration

Published in *Highway Research
Record* n365 p9-16 (1971)

Sponsored by Committee on Road
User Characteristics and presented
at the Highway Research Board
50th annual meeting.

Ten challenges in driver education
and licensing are described. These
include: making sure that research is
useful; securing adequate financing
from legislatures; determining the
effect of driver education on subse-
quent driver performance; establishing
controlled field research projects and
developing needed data; achieving a
consensus on the makeup of the driv-
ing task; developing objective criteria
for safety and flow; developing use-
ful, objective, valid ways to assess
driving proficiency; identifying appro-
priate roles for the education and
licensing processes; and defining rele-
vant data needed in the licensing
process.

Search terms: Driver education eval-
uation; Driver licensing

HS-011 660 Fld. 3/5; 4/3

CALIFORNIA DRIVER TRAIN- ING EVALUATION STUDY. INTERIM PROGRESS REPORT TO THE CALIFORNIA LEGIS- LATURE

by M. H. Jones

California Univ. ITTE

1971 56p

In cooperation with California
Department of Motor Vehicles Busi-
ness and Transportation Agency.

The major purpose of this study is a
benefit-cost analysis of commercial
and public school driver training. The
four main thrusts of the study were:
evaluation of secondary school pro-
grams; comparison of training by
school teachers with credentials vs.
training by commercial school in-
structors; comparison of costs be-
tween secondary and commercial
schools; and comparison of standard
programs with those enriched by four
extra hours of actual driving practice
for both secondary and commercial
schools.

Search terms: Driver education eval-
uation; Driver education costs;
Commercial driving schools; Driver
education laws; Instructors; Cali-
fornia; Benefit cost analysis; High
school driving courses; Behind the
wheel instruction

3/6 Driver Licensing

HS-011 661 Fld. 3/6; 1/5

MICHIGAN DRIVER STATIS- TICS 1971

by J. A. Hayes

Michigan Dept. of State

1971 62p
Report no. MDS-4

A tabulation is presented which de-
scribes the studied population
(5,213,468) in a variety of ways such
as age, sex, license types, license re-
strictions, and 1970 occurrences on
the records. The data presented are
not intended as an accounting but
are designed to identify and describe
Michigan drivers and their 1970
records for comparison in subsequent
years.

Search terms: Driver statistics;
Driver records; Driver license restric-
tions; Driver age; Driver licensing;
Driver license reexamination; Driver
license suspension; Drinking drivers;
Driver intoxication; Traffic law vio-
lators; Convictions; Sex factor in
accidents; Michigan; Driver sex;
Warning letters; Accident causes;
Accident statistics

3/8 Environment Effects

HS-011 662 Fld. 3/8

FREEWAY AND HIGHWAY TRAFFIC NOISE: AN INFOR- MATION BASE FOR URBAN DEVELOPMENT DECISIONS

by S. R. Lane

California Univ.

1971 93p 39refs
Contract DOT-UT-242
Report no. PB-204 434; UMTA-
URT-4(70)-71-2

Presented at the Urban Mass Trans-
portation Administration Confer-
ence, Washington, D. C., Jun 1971.

In the 30 by 50 mile core area of
Los Angeles, there are 350 miles of
freeway which carry a million com-
muters daily and a high level of
truck traffic flow. In general, freeway
traffic causes almost continuous noise
levels of 90 to 70 dB(A) in the five
block wide strips on either side of
the freeways. This study analyzes the
sources of this noise and its effects
on human activity.

Search terms: Freeways; Traffic
noise; Los Angeles; Noise toler-
ances; Acoustic measurement; Vehi-
cle noise; Traffic volume; Sound
intensity; Noise standards; Noise
control; Urban planning

AVAILABILITY: NTIS as
PN-204 434

3/12 Vision

HS-011 663 Fld. 3/12; 5/4

**RELATING INSTRUMENT
PANEL VISIBILITY AND DRIV-
ER PERCEPTION TIME**

by J. L. Sauter; R. B. Kerchaert

Chrysler Corp.

1972 10p 10refs
Report no. SAE-720231Presented at Automotive Engineer-
ing Congress, Detroit, 10-14 Jan
1972.

For the instrument panel designer, good visibility means providing clear, legible, and easy-to-understand instruments and controls free from obstructions, shadows, and inadequate lighting. Unfortunately, most of these provisions are subjective in nature and it is ultimately the designer or group of designers who must decide what is "good visibility." In order to remove some of this subjectivity, a study was undertaken by Chrysler Corp. to find a more objective approach to measuring visibility. In particular, this study dealt with measuring in a quantitative manner the readability of letter patterns used on instruments, controls, and indicators. This report, which covers the main results of the study, deals with the effects of such diverse factors as driver age, illumination, and letter size on a driver's perception time—the time it takes for a driver to take his eyes off the road and read a target on his instrument panel.

Search terms: Instrument panel visibility; Character recognition; Instrument panel lighting; Middle aged drivers; Vision age changes; Driver reaction time; Adult drivers; Visual acuity; Instrument panel design; Driver age; Legibility; Target detection; Perception

AVAILABILITY: SAE

HS-011 664 Fld. 3/12; 5/4

**A PROCEDURE FOR MEASUR-
ING INSTRUMENT PANEL VIS-
IBILITY**

by R. B. Kerchaert; J. L. Sauter

Chrysler Corp.

1972 11p 4refs
Report no. SAE-720232Presented at Automotive Engineer-
ing Congress, Detroit, 10-14 Jan
1972.

Through use of a Luckiesh-Moss Visibility Meter, discreet values of visibility can be assigned to visual targets and related to driver reaction time. Also, eyes off the road lapsed time boundaries may be established which will define visibility requirements necessary to serve the total driver population. These requirements can be translated into meaningful guidelines for visibility attributes such as size, shape, color, contrast, and position of graphics, controls, and indicators.

Search terms: Instrument panel visibility; Visual perception; Character recognition; Driving task analysis; Visual acuity; Driver reaction time; Color perception; Target detection; Vision tests; Instrument panel design; Contrast; Brightness; Measuring instruments; Vision age changes; Laboratory tests

AVAILABILITY: SAE

**4/0 OTHER SAFETY-
RELATED AREAS****4/2 Community Support**

HS-011 665 Fld. 4/2; 2/0

**HIGHWAY SAFETY MANAGE-
MENT, WHAT IT IS AND HOW
TO USE IT**

by J. E. Carnahan

Published in *Traffic Safety* v72 n3
p16-8, 38 (Mar 1972)

There is a need to develop methods and procedures for assessing all highway safety program activities and the needed coordination for implementing them. Highway safety managers need a well-developed program structure that will permit management of comprehensive programs for the total system. This will necessitate considerable improvement in the organizational framework at the local level and some improvements at the state level.

Search terms: Highway safety programs; Highway safety organization management

4/8 Transportation Systems

HS-011 666 Fld. 4/8

**URBAN MASS TRANSPORTA-
TION. BIBLIOGRAPHIC LIST
NO. 6**

by D. E. Willis, Comp.

Department of Transp.

1971 145p 921refs

An annotated listing is provided of selected references to bibliographies, conference proceedings, books, research reports, and periodical articles on urban mass transportation. Most of the references cover the period 1960 through June 1971. Some valuable articles prior to 1960 are included.

Search terms: Bibliographies; Urban transportation; Public transportation

HS-011 667 Fld. 4/8; 4/3

**ROAD TRAFFIC AND SOCI-
ETY IMPACT CONDITIONS**

by V. Johannessen

OCTOBER 20, 1972

OTHER SAFETY-RELATED AREAS—VEHICLE SAFETY

Institute of Transport Economy
(Norway)

1970 37p 18refs

Paper presented at 6th World Highway Conference, International Road Federation, Montreal, Oct 1970.

The purpose of this paper is to stress the importance and usefulness of viewing the problems of increased road transportation from a benefit cost angle. These problems include traffic congestion, noise, pollution, environmental damage, and accidents. The social, cultural, and environmental impacts of road transportation are described and discussed, and these aspects are viewed in relation to price and allocation of resources, in order to provide an improved basis for planning in the seventies.

Search terms: Benefit cost analysis; Norway; Traffic congestion; Public transportation usage; Traffic noise; Automobile urban usage; Vehicle air pollution; Accident costs; International factors; Transportation planning; Environmental factors; Sociological factors

HS-011 668 Fld. 4/8; 4/7

COMPUTER SIMULATION FOR AN AUTOMATED ROADWAY NETWORK

by L. L. Howson

General Motors Res. Labs.

1972 11p 7refs
Report no. SAE-720271

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

The development of a digital computer simulation model for an automated roadway network for an integrated urban transportation concept called the Metro Guideway is dis-

cussed. The initial case study area for the automated roadway simulation is the metropolitan Detroit area as projected for the year 1990. The objectives of the simulation are to determine the performance of the system as a function of various design parameters, to develop operational computer programs, and to evaluate the computer hardware needs of a real-world system. The discussion includes a brief description of the case study area and an overview of the mathematical and computer models.

Search terms: Automatic highways; Computerized simulation; Mathematical models; Traffic flow; Automatic transportation systems; Detroit

AVAILABILITY: SAE

HS-011 669 Fld. 4/8; 5/2; 4/7

DEMAND BUS SYSTEM FOR NEW RESIDENTIAL AREA IN JAPAN

by I. Kaneshige; Y. Funaya; Y. Sakano; T. Ogawa

Isuzu Motors Ltd. (Japan); Fujitsu Ltd. (Japan)

1972 10p 3refs
Report no. SAE-720218

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

The algorithms of a demand bus system that is able to control trips from many origins to many destinations and their simulation techniques are presented. A case study of this system in a newly developed Japanese residential area is illustrated. A digital, fully automatic communication and control system and a bus body design for the implementation of demand bus service is developed.

Search terms: Demand scheduled buses; Algorithms; Japan; Peak hours; Computerized simulation; Flow charts; Trip forecasting; Trip frequencies; Travel time; Trip distribution models

AVAILABILITY: SAE

5/0 VEHICLE SAFETY

5/1 Brake Systems

HS-011 670 Fld. 5/1

A ROAD TEST COMPARISON OF REACTION TIMES USING THE COMBINED BRAKE-ACCELERATOR PEDAL AND THE CONVENTIONAL BRAKE PEDAL AT VARYING SPEEDS AND ROAD CONDITIONS

by P. A. Costain

Naval Postgraduate School

1971 41p 12refs
Report no. AD-733 193

Master's thesis.

The purposes of the road test conducted at Laguna Seca Raceway, Monterey, Calif. were to compare the results with previous results of laboratory experiments and to investigate the effect of moderate speeds and road conditions on brake reaction times. A total of 13 test subjects were used, from 28 to 43 years of age, each contributing 40 reaction times during approximately 16 miles of driving. The combined brake pedal and the conventional brake pedal resulted in average reaction times of .302 seconds and .470 seconds respectively, significant at the .01 level. Compared to the most recent laboratory test the conventional pedal results were almost identical. Results with the combined brake-accelerator pedals were significantly slower. Although slower, the savings in brake reaction time during the road test of

5/1 Brake Systems (Cont'd.)

HS-011 670 (Cont'd.)

.168 second is a 36% reaction time savings which, translated into distance, is approximately 15 feet at 60 miles per hour. Speeds and road conditions were not significant at the .01 level of significance.

Search terms: Brake pedals; Road tests; Brake pedal design; Speed; Braking; Highway characteristics; Test tracks; Test equipment; Driver reaction time

AVAILABILITY: NTIS as AD-733 193

HS-011 671 Fld. 5/1; 4/5; 5/18

DYNAMICS OF AUTOMOBILES DURING BRAKE APPLICATIONS—VALIDATION OF A COMPUTER SIMULATION. INTERIM TECHNICAL REPORT

by R. A. Piziali

Cornell Aeronautical Lab., Inc.

1971 143p 7refs

Contract CPR-11-3988

Report no. CAL-VJ-2251-V-9; PB-204 533

The braking aspects of the Highway-Vehicle-Object Simulation Model (HVOSM) are validated by means of full-scale vehicle experiments. Excellent correlation is achieved in the details of the vehicle response to both straight ahead braking and combined cornering-braking maneuvers. This measurement of vehicle parameters, the instrumentation installed in the vehicle, and test procedures are described. The HVOSM was used to predict the vehicle responses during each braking maneuver, and these are compared with the corresponding measured responses. The details of the correlation are indicated and discussed. The correlation is found to

be excellent. A qualitative assessment of the sensitivity of the computed vehicle responses to a few of the input parameters was made and is presented and discussed.

Search terms: Brake performance; Computerized simulation; Ford Galaxy; Braking; Braking forces; Brake torque; Dynamic braking; Duo servo brake systems; Tire forces; Computer programs; Coefficient of friction; Stopping distance; Simulation models; Validation; Vehicle dynamics; Cornering; Parameters; Mathematical models; Instrumented vehicles; Angular velocity; Brake temperature; Brake fade

AVAILABILITY NTIS: as PB-204 533

HS-011 672 Fld. 5/1; 5/20

EMERGENCY APPLICATION SYSTEMS FOR POWER BRAKE MECHANISMS OF HIGHWAY TRAILER COMBINATIONS. COMPARISON TESTS OF AXLE-BY-AXLE AND VEHICLE-BY-VEHICLE BRAKE PROTECTION SYSTEMS AND EMERGENCY APPLICATION SYSTEMS

Interstate Commerce Commission; Bureau of Public Roads

1970 121p

A report for Advisory Committee on Motor Vehicle Parts and Accessories, Interstate Commerce Commission.

Data from field tests indicated that better stopping performance and prevention of runaways, caused by mechanical failures in a vehicle's power brake system, was afforded by the axle-by-axle brake protection systems. Test data also indicated that in emergency situations, axle-by-axle brake-protection systems gave better braking performance and vehicle control than vehicle-by-vehicle brake

protection systems. Rough and irregular braking performance, such as wheel skidding and wheel bounce, is not desirable in any type of stop and may cause the driver to lose control of his trailer combination.

Search terms: Brake tests; Air brakes; Brake controls; Hand brakes; Parking brakes; Spring brakes; Hydraulic brakes; Brake pedals; Trailer brakes; Truck brakes; Pressure time histories; Power brakes; Axle brakes; Air pressure; Truck emergency brakes; Brake performance; Stopping distance; Braking distance; Brake failures; Field tests; Brake systems; Laboratory tests

AVAILABILITY: GPO \$1.00

5/4 Design

HS-011 673 Fld. 5/4

SAFETY—ANOTHER CRASH PROGRAMME. PT. 2.

by R. Hutton

Published in *Auto Car* v135 n3948 p16-8 (2 Dec 1971)

Emphasis on a crashworthy car as a more realistic goal than a perfect driver is characteristic of the American automotive scene presently. Problems of safety legislation and tight time schedules are described. The safety standards, especially the bumper and air bag requirements, are discussed.

Search terms: Crashworthiness; Vehicle safety standards; Safety design; Air bag restraint systems; Bumper standards; Lead time; Automotive industry

HS-011 674 Fld. 5/4

SOME INTERNATIONAL ASPECTS OF ROAD SAFETY INVOLVING THE NATO COMMUNITY

by R. Brenner

National Hwy. Traf. Safety Administration

Published in *Highway Research Record* n365 p1-8 (1971)

2refs

Sponsored by Committee on Road User Characteristics and presented at the Highway Research Board 50th annual meeting.

The technology of road safety, especially in vehicle safety design, is changing rapidly. The NATO countries are carrying on cooperative research projects on many aspects of road safety. The experimental safety vehicle program is described. The United States is the country most interested in this program, but several other countries are cooperating. International cooperation in the transfer of technological advances is discussed.

Search terms: Experimental vehicles; Safety cars; International factors; United States; Europe; Safety design; Safety research

HS-011 675 Fld. 5/4

VARIABLE COMPRESSION RATIO DIESEL ENGINE

by S. G. Timoney

National Univ. of Ireland

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p356-63

5refs

Report no. SAE-719052

The system described is applicable only to opposed-piston 2-stroke engines. About 2500 hours of running time were attained under output conditions as high as 1.25 bhp/cu. in.

displacement at 2500 rpm and a piston velocity of 1670 fpm. A compact vehicle diesel engine has been designed, using two banks of cylinders with a single crankshaft and a multiplicity of rocker arms on four rocker pivot shafts.

Search terms: Diesel engines; Two stroke cycle engines; Compression ratio; Engine design; Engine speeds; Engine tests; Engine performance; Power output

HS-011 676 Fld. 5/4; 5/15

THE FUTURE OF THE AUTOMOBILE IN AMERICA, 1972, 1981, 1999, 2001

Anonymous

Published in *Motor Trend* v24 n4 p84-6, 88, 90, 122 (Apr 1972)

The probable evolution* of the automobile between 1972 and 2001 is projected, and trends from 1950 to 1972 are reviewed. The movement toward smaller cars will continue and be accentuated. A variety of power plants, particularly the Wankel engine, will develop more and more.

Search terms: Automobile design; Engine design; Forecasting; Compact automobiles; Automobile sales; Propulsion systems; Wankel engines; Consumer preferences

5/6 Fuel Systems

HS-011 677 Fld. 5/6

PERFORMANCE AND EMISSION CHARACTERISTICS USING BLENDS OF METHANOL AND DISSOCIATED METHANOL AS AN AUTOMOTIVE FUEL

by R. K. Pefley; M. A. Saad; M. A. Sweeney; J. D. Kilgroe

Santa Clara Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p36-46

15refs

Contract EHS-70-118

Report no. SAE-719008

The effects of air fuel ratio, compression ratio, and spark advance were investigated using a constant speed full throttle CFR engine. Comparative tests with gasoline indicated that the use of methanol reduced hydrocarbon and carbon monoxide emissions without major changes in engine power and efficiency. Nitrogen oxide levels were similar to those obtained with gasoline. Aldehyde emissions could be controlled by changing the air-fuel ratio and spark advance settings. Preliminary design consideration for a methanol reformer using exhaust energy is discussed.

Search terms: Methanols; Carbon monoxide; Hydrocarbons; Nitrogen oxides; Aldehydes; Exhaust emission tests; Exhaust emissions measurement; Air fuel ratio; Engine performance; Compression ratio; Intake manifolds; Spark ignition engines; Spark timing

HS-011 678 Fld. 5/6

EMISSION AND PERFORMANCE CHARACTERISTICS OF AN AIR-BREATHING HYDROGEN-FUELED INTERNAL COMBUSTION ENGINE

by R. G. Murray; R. J. Schoeppel

Oklahoma State Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p47-51

14refs

Contract EHS-70-103

Report no. SAE-719009

5/6 Fuel Systems (Cont'd.)

HS-011 678 (Cont'd.)

A standard production gasoline engine was converted to run on hydrogen. It can meet current and 1975 federal emission standards and is capable of exceeding the manufacturer's maximum power rating. It can be assumed that the hydrogen engine produces no hydrocarbon, carbon monoxide, carbon dioxide, sulfur, lead, or organic compound emissions. Its only undesirable exhaust component, oxides of nitrogen, is far less concentrated than the output of its gasoline fueled counterpart. The hydrogen engine is able to operate over extremely lean fuel-air ratios where even these levels of NOX emissions are not greatly significant.

Search terms: Hydrogen fuels; Air fuel ratio; Exhaust emissions; Emission standards; Nitrogen oxides; Internal combustion engines; Engine conversion; Engine performance; Engine tests

HS-011 679 Fld. 5/6

ONE-DIMENSIONAL ANALYSIS OF COMBUSTION IN A SPARK-IGNITION ENGINE

by W. A. Sirignano

Princeton Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p52-62

5refs

Report no. SAE-719010

A theory based upon a concept of turbulent flame propagation has been developed and has resulted in the calculation of pressure versus crank angle and temperature versus both crank angle and chamber position as

a function of various design parameters. Ultimately, the theory would result in the calculation of nitric oxide concentration. The results indicate that a broad flame exists and that thin flame theories are not desirable. Turbulent mixing occurs to a significant extent throughout the chamber especially for larger turbulent eddy sizes. After burning is completed, the mixing tends to uniformize the temperature distribution.

Search terms: Spark ignition engines; Flame propagation; Nitric oxide; Combustion chamber swirl; Mathematical models; Fuel mixture temperature; Equations of motion; Unburned fuels; Combustion chamber design

HS-011 680 Fld. 5/6

THE ROLE OF COMBUSTION PRODUCT QUENCHING IN THE DIVIDED CHAMBER ENGINE

by I. A. El-Messiri; H. K. Newhall

Wisconsin Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p63-9

8refs

Report no. SAE-719011

A series of tests were performed in which two divided combustion chamber configurations differing only in relative primary and secondary volumes were compared. Of the many variables that normally influence nitric oxide emissions, only the rate of quenching differed significantly between the two configurations. It is demonstrated that the quenching process associated with the divided chamber is the chief mechanism responsible for the previously observed suppression of nitric oxide. Such quenching processes can achieve

nitric oxide reductions in excess of ninety percent relative to emissions from conventional combustion chambers.

Search terms: Nitric oxide; Combustion chamber design; Air fuel ratio; Quench phenomenon; Engine operating conditions; Combustion rate; Engine tests

HS-011 681 Fld. 5/6

THE AUTOMOTIVE GAS TURBINE AND NITRIC OXIDE EMISSIONS

by T. Mikus; J. B. Haywood

Massachusetts Inst. of Tech.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p70-9

14refs

Grant NSF-GK-15409

Report no. SAE-719012

A mathematical model is shown to closely predict relative nitric oxide (NO) emission trends for an existing engine, while predicting absolute levels within a factor of 2. A future automotive turbine cycle is described. Engine performance and NO emissions are calculated for this cycle. The trade-off between fuel consumption and NO emissions for conventional combustor design is presented as a function of turbine inlet temperature. The methods, by which NO emissions can be reduced are examined. It is found that to meet the proposed 1976 federal emission standard for NO_x, the combustor's primary zone must be made considerably leaner and more homogeneous than is typical of current combustor designs.

Search terms: Nitric oxide; Mathematical models; Gas turbine engines;

Exhaust emission standards; Fuel consumption; Engine performance; Exhaust emission control; Fuel mixtures; Engine operating conditions; Operating temperature

HS-011 682 Fld. 5/6

HYDROGEN AND OXYGEN COMBUSTION FOR POLLUTION FREE OPERATION OF EXISTING STANDARD AUTOMOTIVE ENGINES

by P. Underwood; P. Dieges

Perris Smogless Automobile Assoc.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p317-22

11refs

Report no. SAE-719046

Road tests have been made using gaseous and cryogenically stored propellants with data based on the gaseous tests showing promise that the system can be technically and economically sound as a solution to the exhaust pollution problem. Tests using a very rich hydrogen to oxygen mixture ratio to eliminate combustion knock and crankcase explosions, and a re-circulation system to recover unburned fuel from condensed exhaust water for reuse in the cycle are described. Changes to the Otto cycle engine were made to the fuel induction, exhaust, and cooling systems. Utilization of waste exhaust heat to vaporize the exhaust water improves the thermodynamic performance of the system.

Search terms: Otto cycle engines; Oxygen; Hydrogen; Exhaust gas recirculation; Knock; Heat recovery; Engine modification; Road tests; Rich fuel mixtures; Unburned fuels; Exhaust emission control device tests; Air fuel ratio

HS-011 683 Fld. 5/6

THE NO-CONTENT IN THE EXHAUST GASES OF A STIRLING ENGINE

by A. P. J. Michels

Philips' Gloeilampenfabrieken N.V. (Netherlands)

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p1010-23

14refs

Report no. SAE-719134

The effect of flue gas recirculation on the NO concentration of Stirling engines is investigated. The calculated values are compared with the results of experimental analyses on a Stirling engine heated by hydrocarbon combustion. Calculations of nitric oxide (NO)-formation in a current burner show that it is greatly dependent on temperature. The low concentration in the exhaust of a Stirling engine is due to the short residence time of the flue gases in the combustion chamber. The recirculation of exhaust is an effective means of reducing the NO-emission and results in only a minor decrease in brake horsepower and total engine efficiency.

Search terms: Nitric oxide; Stirling engines; Exhaust gas recirculation; Fuel mixture temperature; Fuel combustion; Flue gases; Mathematical models; Exhaust emissions measurement; Simulation models; Exhaust emission control; Laboratory tests; Engine tests; Forecasting; Power output

HS-011 684 Fld. 5/6; 4/7

MODELS OF COMBUSTION AND NITROGEN OXIDE FORMATION IN DIRECT AND INDIRECT INJECTION COMPRESSIGN-IGNITION ENGINES

by E. K. Bastress; K. M. Chng; D. M. Dix

Northern Res. and Engineering Corp.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p364-75

7refs

Contract EHS-70-116

Report no. SAE-719053

Mathematical models have been developed for predicting indicated performance and NO emission rates for direct and indirect-injection diesel engines. Processes of fuel injection, vaporization, mixing, and ignition are represented explicitly in the models as well as the non-uniform distributions of temperature and composition in the air charge. The ability of the models to predict realistic correlations between engine design and performance parameters has been demonstrated.

Search terms: Mathematical models; Nitric oxide; Combustion rate; Diesel engines; Fuel mixtures; Fuel injection; Engine performance; Parameters; Injection timing; Thermodynamic properties; Engine design; Exhaust emissions

HS-011 685 Fld. 5/6; 5/4

A NEW CONCEPT FOR REDUCED FUEL CONSUMPTION IN INTERNAL COMBUSTION ENGINES

by J. I. Hope; R. D. Johnston

Engine Systems, Inc.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p346-55

Report no. SAE-719051

5/6 Fuel Systems (Cont'd.)

HS-011 685 (Cont'd.)

A new engine concept is proposed which will result in a 25 to 30% reduction in specific fuel consumption over today's automotive diesel along with an increase in horsepower per installation volume and weight of approximately 100%. The engine will not require a conventional air or water cooling system. These advances are made possible by the introduction of high temperature materials and turbo components into a turbo-compound, compression-ignition engine which converts much of the heat energy formerly lost to the cooling system into useful work.

Search terms: Internal combustion engines; Fuel consumption; Turbochargers; Pistons; Gas turbine engines; Heat recovery; Engine design; Diesel engines; Engine size; Engine performance; Cylinders; Heat resistance; Single cylinder engines

HS-011 686 Fld. 5/6; 5/4

THE UTILIZATION OF INTERNAL COMBUSTION EXHAUST GASES FOR AIR CONDITIONING

by M. P. Boyce

Texas A and M Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p1240-8

5refs

Report no. SAE-719162

The system consists of a turbocharger which compresses more air than is required for the engine. Compressed air is then ducted through an inter-cooler to a turbine where it is expanded to about 40°F and then sent through a dehydrator into the passen-

ger compartment. The air which is not sent through the cooling turbine is mixed with high pressure air from the compressor driven by the cooling turbine and then ducted into the engine intake. The simulation of various diesel engines indicates that sufficient energy is available to achieve the desired cooling for passenger comfort in most diesel engine applications. The main applications of the system would be on large interstate trucks and army tanks.

Search terms: Exhaust gas recirculation; Air conditioning; Turbochargers; Diesel engine exhaust emissions; Manifold air pressure; Engine design; Air flow; Simulation models

5/14 Occupant Protection

HS-011 687 Fld. 5/14; 3/4

AN INVESTIGATION OF THE EFFECTS OF THE OAKLAND COUNTY MULTI-MEDIA SAFETY BELT CAMPAIGN

by A. Pryor

Michigan Univ. Hwy. Safety Res. Inst.

1970 24p refs

A campaign conducted to increase the percentage of seat belt users among drivers is evaluated. Attitudinal and behavioral surveys of adult driver populations and a small-scale interview survey of school children revealed very scant evidence of an increase in seat belt usage. The data clearly show that the mass media messages were attended to and comprehended by a large segment of the adult population of Oakland County.

Search terms: Seat belt campaigns; Seat belt usage; Driver attitudes; Safety program effectiveness; Safety propaganda; Mass media; Michigan; Driver interviews; Children; Driver behavior

5/15 Propulsion Systems

HS-011 688 Fld. 5/15

RAPID CHARGING BATTERIES FOR ELECTRIC PROPULSION SYSTEMS

by R. H. Sparks

McCulloch Corp.

1972 13p 7refs
Report no. SAE-720109

Presented at Automotive Engineering Congress, Detroit, 10-14 Jan 1972.

Requirements and constraints for rapid charging batteries used for both pulse load and deep cycle service are outlined. Methods for fast recharging nickel-cadmium and lead acid batteries are described. A new rapid charge concept wherein nickel-cadmium batteries are both rapid charged and reconditioned is presented. Similarly, a unique method of fast charging lead acid batteries is described and illustrated. Areas of required technology improvements in batteries and electronic control devices for rapid charge application are outlined.

Search terms: Lead acid batteries; Nickel cadmium batteries; Battery charging; Depolarization; Battery charging time

AVAILABILITY: SAE

HS-011 689 Fld. 5/15

LITHIUM/SULFUR BATTERIES FOR ELECTRIC VEHICLE PROPULSION

by M. L. Kyle; H. Shimotake; R. K. Steunenberg; F. J. Martino; R. Rubischko; E. J. Cairns

Argonne National Lab.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p80-95

34refs

Report no. SAE-719013

Laboratory investigations have indicated that lithium sulfur cells show promise of meeting the requirements of a low-cost \$10/kW-hr high-specific-energy (200 W-hr/kg), high-specific-power (200 W/kg) secondary battery. Test results are consistent with the specific energy and specific power goals, but the cycle life and the sulfur electrode performance require further improvement. Calculations were performed to estimate the range of a 1950-kg electric automobile powered by a 488-kg battery. Ranges of about 240 km (150 miles) for various driving cycles appear feasible.

Search terms: Lithium sulfur batteries; Molten salt batteries; Electric automobile range; Battery life; Secondary batteries; Battery design; Laboratory tests; Performance tests; Mathematical models; Corrosion tests

HS-011 690 Fld. 5/15

AN EXPERIMENTAL VEHICULAR ZINC-AIR BATTERY WITH REPLACEABLE ANODES

by R. R. Witherspoon; E. J. Zeitner; H. A. Schulte

General Motors Res. Labs.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p96-102

2refs

Report no. SAE-719014

The zinc-air system provides adequate power and energy storage for a 150-160 mile range for small electric

vehicles. Tests showed that the mechanically rechargeable system is impractical for large power vehicle applications. Problems encountered were: the time involved for changing anodes and electrolyte was excessive; temperature changes in the battery caused large volume changes in the electrolyte; electrolyte leakage from overflow of the cells caused minor shorts and zinc metal trials because of electrolysis; and excessive condensation took place in the battery cases after running at high power levels.

Search terms: Zinc air batteries; Battery life; Anode materials; Electric automobile range; Battery charging; Battery weight; Battery design; Battery cases

HS-011 691 Fld. 5/15

CITY CAR WITH H₂-AIR FUEL CELL/LEAD BATTERY (ONE YEAR OPERATING EXPERIENCES)

by K. V. Kordesch

Union Carbide Corp.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p103-11

23refs

Report no. SAE-719015

An urban automobile powered by a hybrid system consisting of a 33-kWh fuel cell battery and a secondary battery of 25-kW peak power output is described. The car has a driving range of 200 miles, and can be refueled in three minutes. The car weighs 2,000 pounds and carries four passengers. Its power system was designed to give it the acceleration of a conventional small car in stop and go traffic and also extend 50 mph driving ability. Performance data collected

during actual operation of the vehicle in summer and winter weather, hill climbing, and long-distance driving are presented. Maintenance needs, cost of fuel cell operation, reliability, and life-expectancy questions relating to the prime power source and the secondary battery system are discussed.

Search terms: Hydrogen air fuel cells; Electric automobile range; Hybrid batteries; Lead acid batteries; Secondary batteries; Urban automobiles; Performance characteristics; Battery life; Compact automobiles

HS-011 692 Fld. 5/15

THE DEVELOPMENT OF HIGH PERFORMANCE ELECTRIC VEHICLES AND SUPPORT SYSTEMS

by W. Goldman

Anderson Power Products

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p112-7

Report no. SAE-719016

An electric highway vehicle with replaceable battery packs containing 12 lead-acid batteries, wired together in series, is described. Two packs are connected in parallel within the frame to provide 72-volt operation. The car can be refueled every 80-100 miles by pulling into a service station, where the discharged battery pack is replaced with a fully charged pack in a few minutes.

Search terms: Lead acid batteries; Battery charging time; Battery life; Electric automobile range; Battery weight; Secondary batteries; Battery design; Battery packs; Electric automobile design

HS-011 693 Fld. 5/15

FABRICATION AND INITIAL TESTING OF AN EXPERIMENTAL ZINC-OXYGEN BATTERY FOR ELECTRIC VEHICLES

by G. Caprioglio; A. Weinberg

Gulf General Atomic, Inc.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference 1971, Proceedings* (P-38), New York, 1971 p140-6

Report no. SAE-719020

An experimental zinc-oxygen battery, with solid zinc electrodes and electrolyte circulation, has been fabricated, assembled on an electric vehicle, and tested. The various phases of the engineering scale-up, design, fabrication, and testing are discussed. The possible applications of the battery in the field of commercial electric vehicles are reviewed.

Search terms: Electric vehicles; Battery design; Zinc oxygen batteries; Performance tests; Electrodes

HS-011 694 Fld. 5/15

POWER SYSTEM COMPONENTS FOR BATTERY ELECTRIC VEHICLES

by B. S. Hender

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p147-51

Report no. SAE-719021

The ultimate viability of battery electric vehicles depends on economic acceptability. Careful attention to power system component selection and design can assist in reducing

costs and ensure maximum utilization of the limited amount of energy which is carried. This applies in the first instance to the battery through the considerable effects of type, plate height, and voltage on capacity and energy density. It is shown that these factors may be of greater importance than the individual smaller savings obtained through adjustments to other components which may be relatively expensive. The importance of correct correlation of component design is stressed.

Search terms: Battery weight; Electric vehicles; Electric automobile design; Battery design; Economic factors

HS-011 695 Fld. 5/15

A COMPACT SUPERCRITICAL STEAM ENGINE FOR AUTOMOTIVE POWER

by R. E. Engdahl; E. S. Tillman

Energy Res. Corp.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p802-12

10refs

Report no. SAE-719110

The use of high pressure and high temperature supercritical steam is made possible by a unique vane type position displacement expander. All of the sliding contacts in this expander are silicon carbide rubbing against a specially coated graphite. No additional vane lubricant is required other than the working fluid because of the extremely low coefficients of sliding friction. The primary control of the system is by varying the admission angle of the expander while the combustion and feed water flows are automatically adjusted to

supply the required rate of steam. A freezing protection system is discussed which safeguards the system to -40°F. The advantages of the system include rapid starting, fuel consumption in the 15 miles per gallon range, desirable emission characteristics, and production costs comparable to present auto engines.

Search terms: Steam engines; Engine design; Lubricants; Expander design; Engine performance; Thermal factors; Boilers; Steam condensers; Performance characteristics; Antifreezes; Engine size; Operating temperature; Operating pressure; Carbides; Graphite

HS-011 696 Fld. 5/15

THE THERMAL PERFORMANCE OF FLUIDS IN A RANKINE CYCLE POWER PLANT FOR AUTOMOTIVE APPLICATIONS

by H. L. Solberg; K. H. Hawks

Purdue Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p813-23

3refs

Report no. SAE-719111

See HS-010 366 for longer version.

Nine fluids were selected for a study of the effects of such factors as regenerative feed-liquid heating, changes in operating pressures and temperatures, feed-pump efficiency, engine efficiency, boiler efficiency, and condenser capacity. Of the fluids studied, steam, CP 34, and Freon 113 showed the best performance in that order.

Search terms: Rankine cycle engines; Steam engines; Condensers; Thermodynamic properties; Operating pressure; Operating temperature;

Freon engines; Engine operating conditions; Thermal efficiency; Mathematical analysis; Fuel pumps

HS-011 697 Fld. 5/15

LOW-POLLUTION CLOSED BRAYTON CYCLE ENGINE

by A. Pietsch; R. A. Rackley

AiResearch Mfg. Co.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p824-8

2refs

Report no. SAE-719112

The engine consists of a single shaft recuperated gas turbine operating with air in a closed loop, including a combustion input heat exchanger and a heat rejection heat exchanger. Low exhaust emission pollution is achieved by a combustor that achieves complete combustion with only a slight excess of air. Formation of oxides of nitrogen is controlled by limiting the maximum combustion gas temperatures. The size, weight, and fuel consumption of the engine are described. Based on complete system tests, the noise level of the closed Brayton engine is very low, the predominant noise being from fans and accessories.

Search terms: Brayton cycle engines; Engine design; Nitrogen oxides; Fuel consumption; Fan noise; Engine noise; Heat exchangers; Combustion; Gas turbine engines; Engine size; Operating pressure; Operating temperature; Engine performance; Engine tests

HS-011 698 Fld. 5/15

POTENTIAL APPLICATIONS FOR THE SUPERFLYWHEEL

by D. W. Rabenhorst

Johns Hopkins Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p1118-25

9refs

Report no. SAE-719148

A superflywheel rotor which can be made to store 30 watt-hours of energy per pound is described. Advantages over alternate energy storage systems are listed. Such a system will be a reality in the near future, and its use will not be restricted to low emission vehicles. A number of typical applications are briefly described.

Search terms: Flywheels; Energy storage systems; Mechanical energy storage

HS-011 699 Fld. 5/15

FLYWHEEL AND FLYWHEEL/HEAT ENGINE HYBRID PROPULSION SYSTEMS FOR LOW-EMISSION VEHICLES

by G. L. Dugger; A. Brandt; J. F. George; L. L. Perini

Johns Hopkins Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p1126-41

28refs

Report no. SAE-719149

Hybrid systems using spark-ignition, diesel, gas turbine, or steam engines, in cars, vans, and buses are considered, and potential flywheel systems are discussed. Experimental spin tests of small-diameter, 30-inch-long rods (or bars) already have demonstrated energy densities up to 48 watt-hours of energy per pound for boron filaments and 36 w-hr/lb for a graphite-epoxy composite. A crucial

question is safety, and these tests indicate that rotors made of brittle graphite or glass materials may have a much more favorable (self-pulverizing) failure mode than metal disks.

Search terms: Flywheels; Hybrid engines; Boron; Graphite; Composite materials; Exhaust emissions measurement; Engine design; Engine performance; Mathematical models; Materials tests; Energy storage systems; Propulsion systems; Hybrid automobiles; Hybrid buses; Hybrid trucks; Spark ignition engines; Gas turbine engines; Diesel engines; Engine speeds; Rods

HS-011 700 Fld. 5/15

DESIGN AND TESTING OF HIGH ENERGY DENSITY FLYWHEELS FOR APPLICATION TO FLYWHEEL/HEAT ENGINE HYBRID VEHICLE DRIVES

by L. J. Lawson

Lockheed Missiles and Space Co.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p1142-50

3refs

Contract EHS-70-104

Report no. SAE-719150

Operating characteristics of practical, full-size flywheels with energy storage capacities up to 1.0 kilowatt-hour are summarized. Results of the test programs have verified the specific energy as well as the extremely high levels of specific power available from flywheels. The application of the kinetic energy wheel to flywheel/heat engine hybrid drives for urban vehicles may show potentials as a means of emission reduction.

Search terms: Flywheels; Hybrid engines; Steels; Exhaust emissions

5/15 Propulsion Systems (Cont'd.)

HS-011 700 (Cont'd.)

measurement; Energy storage systems; Urban automobiles; Energy densities; Materials tests; Failures; Mathematical analysis

HS-011 701 Fld. 5/15

AN EVALUATION OF HYBRID HEAT ENGINE/ELECTRIC SYSTEMS FOR LOW EXHAUST EMISSION POTENTIAL IN AUTOMOTIVE APPLICATIONS

by D. E. Lapedes; J. Meltzer

Aerospace Corp.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p1151-62

4refs

Contract F04701-70-C-0059

Report no. SAE-719151

A full-size 4000-lb family car and a two-passenger 1700-lb commuter car with design specifications for acceleration, gradeability, peak cruise speed, and maximum weight/volume assignable to the powertrain are discussed. Several versions of advanced heat engines were coupled in the powertrain with a variety of battery-electric motor combinations. Performance characteristics for the powertrain components based on available data were used in analyses which revealed the exhaust emissions that may be expected from hybrid electric vehicles operated over representative driving cycles. Required performance levels for critical powertrain components were also established.

Search terms: Power trains; Hybrid engines; Spark ignition engines; Lead acid batteries; Engine design; Exhaust emission tests; Urban automobiles; Engine performance;

Hybrid automobiles; Electric automobiles; Compact automobiles; Power output; Driving conditions

HS-011 702 Fld. 5/15

A STUDY OF BREATHING IN VANE TYPE EXPANDERS

by C. H. Wolgemuth; D. R. Olson

Pennsylvania State Univ.

Published in HS-011 703, *Intersociety Energy Conversion Engineering Conference, 1971, Proceedings* (P-38), New York, 1971 p1249-58

6refs

Report no. SAE-719163

A nondimensional representation of a vane expander for a Rankine cycle power system that includes the transient charging and exhaust processes is described. The design and operating parameters that evolve from this representation are basic in nature and the computer solutions are applicable to all expanders of this type. The work output and efficiency are shown as functions of breathing number, arc of admission, number of vanes, steam supply conditions, and a geometric variable.

Search terms: Expander design; Mathematical models; Computerized simulation; Rankine cycle engines; Steam engines; Variables; Thermodynamic properties

HS-011 703 Fld. 5/15; 5/6

INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, BOSTON, AUGUST 3-5, 1971. PROCEEDINGS

Society of Automotive Engineers, Inc.

1380p refs

Report no. SAE-P-38

Includes HS-011 675, 677-686, 689-702.

Contents include: future power generator methods; advanced automotive engine emissions; electric vehicle systems; power for manned space flight; energy conversion systems for medical applications; thermal power systems for artificial heart applications; advanced automotive engines; biological and ecological effects of emissions; advances in compression ignition engines; power for manned space flight; RTG for advanced missions; underwater power systems; meteorological effects of emissions; nuclear power systems; battery developments; thermal pollution effects; small stationery power sources; closed cycle engines; power systems for advanced missions; space power technology; power system computer simulation; Stirling engines; noise pollution; advances in fusion power plants; heat engine hybrid auto power plants; RTG test and flight results; advances in fossil fuel power plants; and advanced auto engine technology.

Search terms: Batteries; Battery design; Exhaust emissions; Electric automobiles; Engine design; Hybrid engines; Propulsion systems; Power plants; Emissions; Air pollution emission factors; Noise

AVAILABILITY: SAE

5/17 Safety Defect Control

HS-011 704 Fld. 5/17

RALPH NADER VS. VOLKSWAGEN. AN EVALUATION OF THE VOLKSWAGEN: AN ASSESSMENT OF DISTINCTIVE HAZARDS

by J. Tomerlin

Published in *Road and Track* v23 n8 p25-33 (Apr 1972)

refs

The allegations made by Ralph Nader are refuted. According to available crash statistics, to the results of controlled experiments, and to the most qualified engineering analysis, the following is true: The VW Beetle is not abnormally hazardous. It compares favorably with cars of equivalent age and size. Volkswagens do not crash more often or inflict greater injuries on occupants than other cars their size; nor do they appear to offer any unusual risk of fire. While the occupants of small cars suffer more injuries in collisions than occupants of large ones, there is no indication that small cars get into more accidents, and some indication they get into fewer serious accidents than large cars.

Search terms: Volkswagens; Fatality rates; Injury causes; Steering columns; Rollover accidents; Injury severity index; Ejection caused injuries; Accidents by vehicle make; Windshield caused injuries; Accident rates; Accident severity; Door latches; Injuries by vehicle model; Fires by vehicle make; Injuries by vehicle make; Steering wheel caused injuries; Book reviews; Defective vehicles; Automobile defects; Compact automobile accidents; Seat failures; Crashworthy bodies; Fuel tank rupture

5/18 Steering Control System

HS-011 705 Fld. 5/18; 5/20; 2/4; 3/4

AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE EFFECT OF TRUCK-INDUCED AERODYNAMIC DISTURBANCES ON PASSENGER CAR CONTROL AND PERFORMANCE

by D. H. Weir; R. F. Ringland; R. K. Heffley; I. L. Ashkenas

Systems Technology, Inc.

1971 108p 20refs
Contract FH-11-7570
Report no. FHWA-RD-71-3;
TR-1001-1

Report for 24 Jun 1970-30 Sep 1971.

Results of a preliminary study of the nature and magnitude of the aerodynamic effects studied are expressed in terms of overall car/driver safety performance, with emphasis on steering control and side to side deviations in the car's path along the roadway. The situations studied involve a station wagon and a tractor/semitrailer, a two lane road, overtaking and passing, and car-truck oncoming. Parameters varied are: truck width and shape, lateral separation and lane width, ambient wind magnitude and direction, car-truck speeds, car handling properties, and driver skill and alertness. The study comprised full scale experiments, wind tunnel tests, and combined car/driver/disturbance analyses. Results are interpreted in terms of possible actions and remedial implications in the areas of roadway design, truck size and configuration, and car/driver dynamics and control characteristics.

Search terms: Passing; Tractor semitrailers; Driver performance; Aerodynamics; Air flow; Lateral force; Wind tunnel tests; Lane width; Vehicle width; Vehicle width effects on traffic; Lateral vehicle spacing; Station wagon handling; Wind; Crosswind; Highway design; Speed differential; Two lane roads; Oncoming vehicles; Truck design; Attention; Driver skills; Vehicle dynamics; Driver monitoring; Driver vehicle interface

AVAILABILITY: NTIS

HS-011 706 Fld. 5/18; 5/20; 2/4; 3/4

AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION

OF THE EFFECT OF TRUCK-INDUCED AERODYNAMIC DISTURBANCES ON PASSENGER CAR CONTROL AND PERFORMANCE. EXECUTIVE SUMMARY REPORT

by D. H. Weir; R. F. Ringland; R. K. Heffley; I. L. Ashkenas

Systems Technology, Inc.

1971 12p
Contract FH-11-7570
Report no. FHWA-RD-71-2;
TR-1001-1-Summ.

Summary of report for 24 Jun 1970-30 Sep 1971.

For abstract and search terms, see HS-011 705

AVAILABILITY: NTIS

NHTSA DOCUMENTS

NHTSA Contractors Reports

HS-800 690 Fld. 3/6; 3/9; 4/1

REQUIRING PHYSICIANS TO REPORT

National Com. on Uniform Traf. Laws and Ordinances

Published in *Traffic Laws Commentary* v1 n2 p1-29 (Apr 1972)

12refs
Contract DOT-HS-107-1-153

State laws requiring physicians to report to the state driver licensing agency mental or physical conditions of patients that may create an unreasonable accident risk are reviewed. This reporting requirement was added to the Uniform Vehicle Code in November 1971. The major arguments favoring and opposing such a reporting law are summarized. Epilepsy and lapses of consciousness, alcoholism,

**NHTSA Contractor's Reports
(Cont'd.)**

HS-800 690 (Cont'd.)

and drug abuse are the most frequently defined conditions for which reporting is required.

Search terms: Driver physical fitness; Driver mental fitness; Uniform Vehicle Code; Driver license laws; Alcoholism; Drug addiction; Epilepsy; Physicians and highway safety; Blackouts; Medical ethics

AVAILABILITY: GPO \$0.35

SPECIAL ANNOUNCEMENT

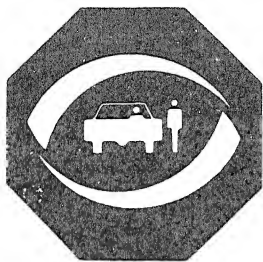
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executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

MULTIDISCIPLINARY STUDY OF VEHICLE ACCIDENTS IN NORTH CAROLINA. PHASE I

This study was designed as a multidisciplinary accident investigation project to obtain detailed data relating to the human, the vehicle, and the environment factors which are involved in all motor vehicle accidents.

Contract No. FH-11-7215
Research Triangle Institute
Statistics Research Division
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Award Amount: \$167,575.00
Contractual Period:
June 12, 1969 through September 30, 1971

DOT/HS-800 459 Phase I Final Report

STUDY OBJECTIVES

This in-depth study was deemed necessary in order to (1) determine accident causation, (2) identify injury causation, (3) evaluate the effectiveness of the new safety features, (4) provide early detection of design and functional problems of the vehicle and highway, (5) evaluate the Federal Motor Vehicle Safety Standards, and (6) evaluate the Federal Highway Safety Program Standards.

GENERAL COMMENTS

This report contains the findings of multidisciplinary investigations of 30 collisions (Phase I). The three elements (human, vehicle, and environment) common to all collisions were investigated in three phases (pre-crash, at-crash, and post-crash).

These results are intended to be used by the National Highway Traffic Safety Administration and/or other agencies in conjunction with the data from the other 15 similar teams. A compilation of this data from all teams would provide a significantly large base, so that

meaningful conclusions and recommendations could then be made.

Phase II of the study will include 25 additional investigations. Its findings will be contained in a separate report upon completion of the investigations.

STUDY PROCEDURES

Study procedures are discussed in terms of the geographical area of accident investigation, the alerting system, the at-scene investigation, the follow-up investigation, and case reports.

CONCLUSIONS AND RECOMMENDATIONS

The number of collisions reported in-depth in this study was indeed small. However, the qualifications, training, and experience of the team members, coupled with the related literature review necessary prior to and in conjunction with this study, permit the following conclusions to be drawn.

The largest and quickest reduction in the nation's highway death and injury toll can be accomplished by

implementing changes in two areas. One is directed toward reducing the number of collisions, while the other's purpose is to prevent death and injury when a collision does occur.

1. Removal of the Alcohol-Impaired Driver from the Highway.

Efforts should cover the whole spectrum of drinking drivers instead of concentrating on the "chronic" or "problem" drinker alone. Many studies are available which show that the average blood alcohol level of fatally injured drinking drivers exceeds 0.15%. But we are aware of few studies that have tested all drivers involved in collisions to determine blood alcohol levels regardless of the severity of their injuries. In our study we have observed many injury-producing collisions in which it was known that a driver had been drinking, but no chemical test could be made to determine his blood alcohol level because of his injuries.

North Carolina State Highway Patrol records reveal a surprisingly high average breathalyzer reading (0.16 percent in 1970) for drivers arrested for driving under the influence. This high average likely results from law enforcement officers concentrating on drivers well above the presumptive level of 0.10 percent in order to obtain convictions in courts which have a poor record of convicting those charged with driving under the influence.

It is the opinion of the contractor that a pilot study should be initiated to obtain blood alcohol levels of all drivers involved in collisions. This would necessitate legislative action to require physicians and hospitals to furnish blood samples for analysis when the driver is unable to take a standard breath test. We believe this is the only way to determine the relationship of alcohol impairment to collision probability, which is needed in order to initiate an effective countermeasures program on a cost-benefit basis. Also, it is the contractor's belief that the publicity given to the "problem or chronic" drinking driver will tend to lead "social" drinkers to believe that drinking and driving is only dangerous when one has reached the point where he should be committed to an institution.

One possible method to remove the drinking driver from the highway would be to establish a blood alcohol level of 0.10% as legal evidence of intoxication and a presumptive level at a somewhat lower blood alcohol concentration (for example, 0.05%). This should be coupled with a pre-arrest testing of suspected violators provision in the law. Public education to gain acceptance of any new programs is desirable, but, nevertheless, of paramount importance is the removal of impaired drivers from our roads. Whatever methods are employed, death caused by the

drinking driver should be made as unacceptable by the public as homicide.

2. Acceptance and Usage of Available Restraint Systems.

The majority of the motoring public has failed to be convinced by the various educational campaigns that the benefits from restraint usage outweigh the inconveniences involved. This is particularly tragic since restraint systems have proven very effective in injury reduction. Perhaps a new educational program with a novel format would yield some tangible results, but it is not likely to sway public attitude near the desired total acceptance. There are, of course, obstacles in requiring the use of restraints by legislation. As an alternative, automobile insurance companies might implement policies which base the payment of medical benefits upon restraint system utilization.

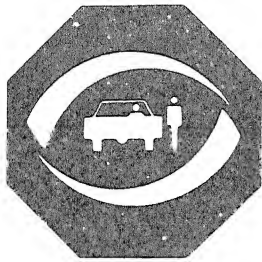
Other areas which would effect further injury reduction include making vehicle interiors more "forgiving" to occupant contact. This could be partly accomplished by the simple addition of padding in strategic locations heretofore mostly unprotected, such as the lower dash and "A" pillars, and by using laminated safety glass for all windows instead of just the windshield.

Also, there are many roads in use today which were designed years ago and are not adequate for today's higher speeds and volumes, and, as a result, safe vehicle operation is more difficult. But improvements can be made to the existing facilities; these include such things as better pavement surfaces and markings, improved signing and signalization, improved shoulders and elimination or alteration of roadside structures when feasible, the addition of guardrail and other energy-attenuating devices, etc. The allocation of limited improvement funds should be based upon cost-effectiveness studies. It is hoped that new roadways will be designed utilizing modern design standards with emphasis on safety potential.

The Contract Technical Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings and conclusions expressed in this summary are those of the contractor and not necessarily those of the National Highway Traffic Safety Administration.

Availability: National Technical Information Service (NTIS), Springfield, Va. 22152. Order in paper copy (PC) or on microfiche (MF), DOT/HS-800 459



executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

TEST PROCEDURES AND REQUIREMENTS FOR DOOR SYSTEM EVALUATION. FINAL REPORT

This report presents the methods and test equipment utilized in conducting static loads on automobile door systems and the conclusions derived from the execution of these tests. The purpose of the tests was to specify minimum strength and performance requirements in order to minimize occupant injuries caused by failure of the adjacent door or opposite door under crash conditions, and to reduce the likelihood of occupant injuries caused by ejection.

Contract No. DOT-HS-005-1-005
Dayton J. Brown, Incorporated
555 Church Street
Bohemia (Suffolk County),
New York 11716

Award Amount:
Contract Period:
August 25, 1970 through March 31, 1971

DOT/HS-800 473 Final Report

TEST ITEMS

Three different Body in White (B.I.W.) test samples were used to conduct the tests. The B.I.W. consisted of a complete unitized car body and frame including the doors and latches. They did not include the engine, front fenders, hood, trunk lid, glass, trim, seats, instruments or upholstery. The B.I.W.'s selected for testing represented three types of body styles and curb weights for 1971 cars and had body styles and curb weights as follows: 2 door sedan at 2635 pounds, 2 door hardtop at 3400 pounds, 4 door sedan at 3604 pounds. The B.I.W.'s were supplied by American Motors. The 2 door sedan was a Gremlin body, the 2 door hardtop was a Matador, and the 4 door sedan was an Ambassador body.

TEST OBJECTIVES

The B.I.W.'s were tested to determine if the door system, including hinges and latch, met the requirements of Federal Motor Vehicle Safety

Standard (FMVSS) 206 and 214. A second objective of the test was to determine if the required loads of FMVSS 206 and 214 were satisfactory and to determine a method of applying the loads required by FMVSS 206. Changes to FMVSS 206 and 214 were to be recommended as necessary.

CONCLUSIONS AND RECOMMENDATIONS

- o Study of the reference documents and the test results indicate that the loads of FMVSS 206 are adequate compared to the force the occupant's body can impart to the door in an outward direction without sustaining death. However, it is felt that a larger safety factor is required, and that the loads of FMVSS 206 should be increased to 3000 pounds in the longitudinal and transverse directions of the latch and hinges when installed in a car. The loading to

accomplish this requirement would be a 6000 pound load at the center of the door in an outward transverse direction as long as deflection of the door, latch, or hinges takes place. The 1000 pound requirement for the secondary latched position should not be changed since no test other than compliance was conducted to the door in this position.

- o Secondly, it is recommended that the supporting sheet metal structure of the latch and hinges should be improved to bear more load. Observation has shown that the supporting structure usually fails before the latch or hinges. It is felt that the latch should be the weakest part of the door and although it should pass all required loads it should fail before any other part of the door. This would allow any design engineer to have a value that all other areas of the door could be designed around.
- o From the data gathered, it is recommended that improvements will be necessary if the latch must open after major loadings. However, insuring that the latch opens may cause it to lose load bearing capability and it is felt that a compromise may be required to insure that the door remains closed during impact. It is felt that it is more important to have the door remain closed during impact than to open after impact.
- o Although it was not one of the objectives of the test program, it is suggested that the supporting sheet metal structure around the latch striker would bear more load if the plate that the latch striker screws into had rounded edges and corners. It was noted during test that the corners of this plate were the starting points of shear due to their ability to concentrate stress.

The procedures and recommendations discussed in this report have been incorporated into a detailed test procedure recommended for the evaluation of door systems. This procedure or standard is enclosed in Appendix D of the report and specifies the procedures and required loads for intrusion and retention testing of door systems.

In summary, this report discusses the following points:

- o The latch and hinges held and far exceeded all required loads.

- o The latch and hinges should be tested together in a car since, as in actual use, each hinge receives only one-half the load of the latch.
- o The supporting structures and door require improvements since they are the limiting factor in load bearing capability and not the latch or hinges.
- o Egress is not possible after the doors have been subjected to primary retention and intrusion loads. An effort should be made to correct this problem but care must be taken to insure that any design changes do not cause other problems. It is felt that the first point to consider is that the door remain closed during impact. Note that egress improvements may be obtained when the strength of the door's supporting structure is increased, but this would not be known until actual tests are conducted.
- o Transverse loads induce longitudinal loads into the car that will exceed required values as long as some deflection of the door takes place.

The Contract Technical Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of the National Highway Traffic Safety Administration.

Availability: National Technical Information Service (NTIS), Springfield, Va. 22152. Order in paper copy (PC) or microfiche (MF), DOT/HS-800 473



executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

HELICOPTER AMBULANCE SERVICE TO EMERGENCIES (HASTE) FINAL REPORT

The purpose of this project was to determine the feasibility of establishing, operating, and maintaining a helicopter ambulance service to aid motor vehicle accident victims in the eight counties comprising the metropolitan area of the cities of St. Paul and Minneapolis, Minnesota.

Contract No. FH-11-7128

Award Amount: \$320,155.00

Contractor:

Contractual Period:

Metropolitan Inter-County Council

March 25, 1969 through May 15, 1971

55 Sherburne Suite 203

Report Date: March 31, 1971

St. Paul, Minnesota 55103

Administered by:

Minnesota Department of Health

717 Delaware Street, S.E.

Minneapolis, Minnesota

DOT/HS-800 495 Final Report

GENERAL COMMENTS

As a result of the Federal Highway Safety Act of 1966 (Public Law 89-564), 16 safety performance standards were promulgated by the Secretary of the U.S. Department of Transportation, the standards to be used as goals for each state to reach during the next few years. One of these standards was Standard 4.4.11, Emergency Medical Services. Standard 4.4.11 was developed as a result of pertinent statistics gathered by the National Highway Traffic Safety Administration. These statistics showed that many deaths and crippling injuries were not caused by the severity of the accident, but were due to the poor medical attention received at the accident scene and enroute to the hospital. Some were due to inadequate hospital emergency room services.

Minnesota was involved in a survey of ambulance services in 1967, a survey that indicated a need for upgrading in this area. In 1968, a grant was received from the Department of Transportation with which ambulances were placed, on a 50 - 50 matching funds basis, in communities where a demonstrated need existed.

Along with the placement of ambulances in these communities, the Minnesota Department of Health made available an Emergency Care Course designed to train those people who were to man the ambulances. It is a 15-hour course aimed at all people in the community and neighboring communities who are involved in the emergency medical services field, including police, firemen, hospital personnel, and ambulance attendants.

The core cities of Minneapolis and St. Paul generally were not included in the ambulance training program since it was felt that the ambulance services and trained personnel operating the services were adequate in this area and other training facilities were available. However, the eight county area surrounding the core cities of Minneapolis and St. Paul is geographically a rural area in the process of urbanizing. Ambulance response time is generally slow in this rural area.

The accident problem of the metropolitan eight county area was of sufficient magnitude to require special attention in any statewide emergency medical services program. Statistics showed that over 61% of the total accidents (all types) in the state of Minnesota occurred in this eight county area. Nearly 65% of the personal injury accidents occurred in this same area, and over 62% of the traffic accident injuries occurred here. With the building of the freeways which allowed high speed ingress to and egress from the metropolitan area, the accident pattern moved into areas of sufficient distances where lack of expert emergency medical services would lead to a potential rise in permanent injury and unnecessary death.

The use of a helicopter with trained emergency medical service personnel to manage the victim at the accident scene, as well as the capability of rapid transport to major emergency room facilities with attendant expertise when indicated, seemed a rational approach to the mounting traffic problem in the metropolitan area.

Project HASTE (Helicopter Ambulance Service To Emergencies) was conceived to serve the primary purpose of bringing highly trained emergency medical services personnel to the scene of a personal injury accident as quickly as practical, and of transporting the critically injured to hospitals if time was of the essence.

Project HASTE was to be a demonstration project to determine whether a program of this nature was feasible in this eight county area.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The contractor summarizes the conclusions reached as a result of this study as follows:

- o Helicopter ambulance service in a large metropolitan area such as Minneapolis, St. Paul, and suburbs is not feasible because of the limited operational area and because:

- Ground ambulance service with trained personnel is generally available and response time is usually as fast or faster than with the helicopter. (Of the 70 persons transported by helicopter during the study, only 8 were judged to have benefited in a way in which they would not have had they been transported by ground ambulance.
- Large medical facilities with staff and equipment available to care for personal injury accident victims are numerous and within reach of ground ambulance service in a comparatively short time.
- Competition between hospitals and ambulance services is great in the metropolitan area, and hospitals and ambulance services have established a close working relationship with local police and sheriffs.
- The helicopter is restricted regarding landing anywhere in the core cities.
- Police, as a rule, are reluctant to use the helicopter service in a heavily populated area because it may complicate the traffic situation by distracting other drivers, and the officers have enough to do assisting in caring for the injured and maintaining traffic control, without worrying about landing a helicopter.

- o Helicopter ambulance service would be reasonable in the outlying areas of the state because:

Ground ambulance service with adequately trained personnel is not readily available in the remote areas of the state.

Medical facilities are not as numerous and do not have the capabilities of caring for the critically injured. This necessitates transferring the patient to a larger medical facility in a metropolitan area.

- Transfers of the critically injured from outlying hospitals to a metropolitan area via helicopter with its greater

speed and smoother ride would be the greatest service a helicopter could offer.

However, the contractor points out that, to be financially feasible and practical the helicopter would have to have a multipurpose use such as police utilization in patrolling, searches, criminal pursuit, etc., transfer of newborn babies with serious surgical or medical problems to the metropolitan area, and the flying of blood or equipment to a medical facility outstate when an emergency arises.

RECOMMENDATIONS

Some general recommendations made by the contractor regarding future projects of this type included:

- o The base of operations should be as centrally located as possible, when a large area is involved, and guidelines set down as to which hospital should receive the patient.
- o Procedural guidelines should be spelled out in detail in the planning stage and then emphatically enforced during the operation of the program.
- o Guidelines should be set down for all hospitals using emergency helicopter services such as rapid transit of blood.
- o Administrators in projects such as HASTE should have both managerial and financial control: managerial control to carry out policies as recommended by the governing committees, and financial control to alleviate delays in receiving approval for specific expenditures.
- o Consideration should be given to whether a paid fulltime, permanent crew of three or four PRIMS (professional Rescue Instructors of Minnesota) man the helicopter would have been more desirable than using a large group of volunteers
- o The helicopter contractor should be compelled to post bond so that the contract would be protected should a breach of contract by the helicopter operator occur. The helicopter contractor for this study went out of business and detailed records necessary for cost analysis were not available. The program contractor feels,

however, that to be "cost-effective" it would seem that a program must involve multiple uses for a helicopter operating outside a large metropolitan area.

The Contract Technical Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of the National Highway Traffic Safety Administration.

Availability: National Technical Information Service (NTIS), Springfield, VA. 22152. Order in paper copy (PC) or microfiche (MF), DOT/HS-800 495



executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

NATIONAL ACCIDENT SUMMARY STATE SYSTEMS MANUAL

FINAL REPORT

The objective of this project was to develop a manual containing criteria which would provide uniformity to the input data supplied by the 50 States and the District of Columbia to the National Accident Summary (NAS).

Contract No: DOT-HS-011-1-011
Exotech Systems, Inc.
525 School Street, S.W.
Washington, D. C. 20024

Award Amount: \$39,943.00
Contractual Period:
October 21, 1970 through May 19, 1970
Report Date: June 1971

DOT/HS-800 523-Volume I-Preparation of Input PB-204 184
DOT/HS-800 524-Volume II-Data Retrieval and File Use

BACKGROUND

The National Accident Summary, developed and maintained by the National Highway Traffic Safety Administration (NHTSA) of the Department of Transportation, has the objective of accumulating summary data on a nationwide basis concerning high traffic units, accident assignments, fatalities, and injuries as a function of the nature of the accidents and the variables involved, and from these data to make available national statistics that permit study of many aspects of the occurrence of accidents on the nation's highways.

When the typical automobile accident is reported, the investigating official generates a written report describing the accident in detail. A report, prepared on any of the forms developed by States and highway authorities, records factors pertaining to the nature of the accident, its locale, and the participants. These reports are collected by States and are the source for their traffic accident records. State records, in turn, are sources of information sent to the NHTSA for the

National Accident Summary. When the State Summaries are merged in the NHTSA system, the individual state statistics are not distinguishable in the National File.

It is a goal of NHTSA that the summaries from 50 State files (and the District of Columbia) collected and incorporated in the National Accident Summary. The large number involved requires that individual inputs must be in a compatible form so that they may be merged by automatic data processing. There is, therefore, a need for (1) standardized definitions to be used in the assembling of the State files, and (2) identity of structure for all files so that they can be merged. The interface between State and the national files has required lengthy communication, explanation, and trial-and-error efforts in order for each state's records to be processed into the format of the national file.

GENERAL COMMENTS

This manual documents the procedures developed for accomplishing the objectives of the NAS as described

above. Volume I, describes the need for and the methodology used for (1) standard definitions for the assembling of State files, and (2) identity of structure for all files so they can be merged.

Volume II of this manual, "Data Retrieval and File Use," provides guidance for users of the National Accident Summary (NAS) File. The NAS System is described in terms of purpose, what it comprises, who prepares and maintains it, and how its content is organized. Detailed information about the data currently available to user is presented; descriptions of the data retrieval and processing programs currently operational within this system are given; and the utility of the NAS File in various applications is discussed. The volume concludes with the details concerning the procedures for users to follow in order to obtain effective service from the National Accident Summary System.

The Contract Technical Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of the National Highway Traffic Safety Administration.

Availability: National Technical Information Service (NTIS), Springfield, Va. 22152. Order in paper copy (PC) or microfiche (MF), DOT/HS-800 523 for Volume I-Preparation of Input, and DOT/HS-800 524 for Volume II-Data Retrieval and File use.

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Research Institute, Office of Accident Investigation and Data Analysis

WASHINGTON, D.C. 20590

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III	Regional Administrator, NHTSA, Room 817 Federal Building, 31 Hopkins Plaza, Baltimore, Maryland 21201 Tel: 301-962-3878. (Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia)
IV	Regional Administrator, NHTSA, (Suite 400) 1720 Peachtree Road, N.W., Atlanta, Georgia 30309, Tel: 404-526-5537. (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee)
V	Regional Administrator, NHTSA, Suite 214, Executive Plaza, 1010 Dixie Highway, Chicago Heights, Illinois 60411, Tel: 312-756-1950 (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin)
VI	Regional Administrator, NHTSA, 819 Taylor Street, Room 11A26, Forth Worth, Texas 76102, Tel: 817-334-2021. (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas)
VII	Regional Administrator, NHTSA, P.O. Box 7085, County Club Station, Kansas City, Missouri 64113, Tel: 816-361-0860 (Ext. 7887) (Iowa, Kansas, Missouri, and Nebraska)
VIII	Regional Administrator, NHTSA, 330 South Garrison Street Lakewood, Colorado 80226, Tel: 303-234-3253 (Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming)
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X	Regional Administrator, NHTSA, 5140 Federal Office Building, Seattle, Washington 98104, Tel: 206-442-5934 (Alaska, Idaho, Oregon, and Washington)